The FOUNDRY

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Castings Aid in Keeping Up Personal Appearances

CLOTHES may not make the man or woman, but they undoubtedly go a long way toward creating impressions. Through extensive advertising campaigns, the public has been educated to the fact that it is much more convenient to have garments cleaned and pressed in establishments specializing in that sort of work than to attempt

Courtesy United States Hoffman Machinery Corp.

Pressing Room of a Large New York Hotel Has a Great Number of Machines Installed

the cleaning and pressing operations in the home. Due to the wide variety of efficient machinery which has been developed to meet the needs of the industry, exceptional results are secured at a reasonable cost. The National Association of Dyers and Cleaners estimate that the business of dry cleaning and dyeing plants of the country amounted to $250,000,000 in a recent year and that business of pressing shops totaled $80,000,000. There are approximately 2400 establishments of that type in the United States representing an investment of $28,700,000. The pressing business has grown large in recent years. Castings play an important part in equipping a plant designed for cleaning, pressing or dyeing. Many different types of machinery are necessary such as filtering machines, tumblers, washers, pleating machines, pressing machines, etc. The product of the foundry constitutes an important engineering material in the design of such equipment.

Find Where Castings Can Be Sold.

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FOUNDRY *To Meet* QUALITY

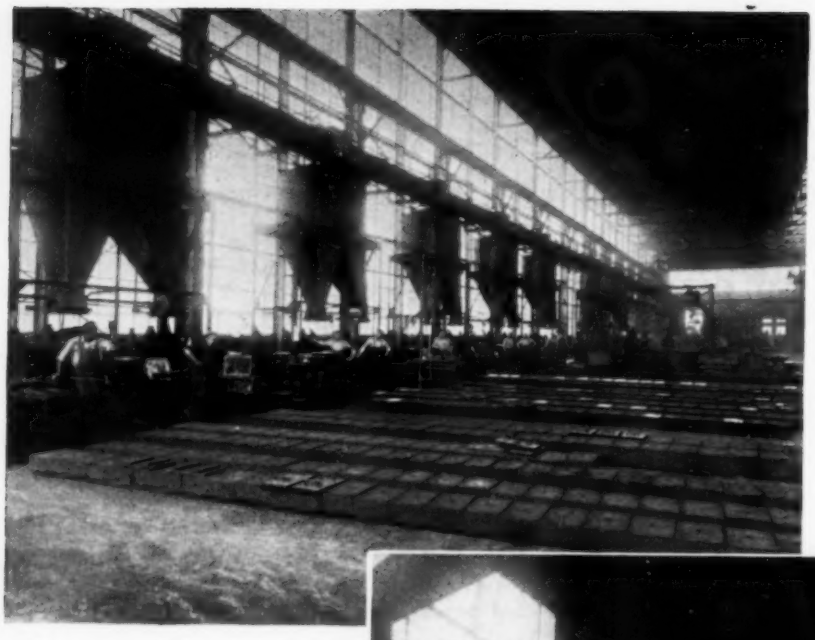


Fig. 1 (Above) — Small Green Sand Molds Are Made on Machines Located Under Sand Hoppers

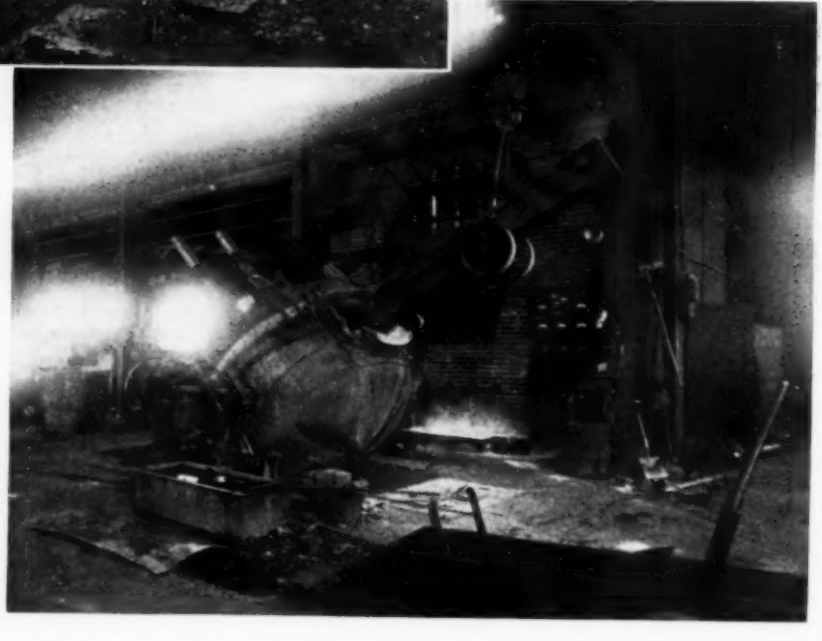
RECENT completion of an extensive addition to the plant of the Industrial Steel Casting Co., Toledo, O., brings its casting capacity up to 500 tons per month and is the most elaborate of the four phases of an extension program through which the company has passed during the ten years it has been in existence. Another change, already in contemplation will carry the main foundry building for a considerable distance to the north where it will be utilized principally for cleaning and shipping.

About ten years ago the casting requirements of a prominent Toledo railroad equipment manufacturer assumed such proportion that the management was led to consider several plans for insuring a prompt and ample supply of small steel castings to meet its somewhat exacting specifications.

The result of the deliberations was the formation of the Industrial Steel Casting Co., which took over and reopened in the east end of the city a small electric steel foundry which with many other war enterprises had failed to win through the period of high financial and commercial mortality that marked the two or three years after the war.

A little new equipment was installed, a staff was organized and operations were started on a modest scale. With the railroad equipment work as a nucleus, the scope of activities was extended gradually into many other lines. This extension has been kept up steadily until at present the tonnage of miscellaneous castings

Fig. 2 (Left)—Where the Sand Is Collected and Prepared. Fig. 3 (Below)—Long Steel Pans Are Employed to Charge the Furnace



EXPANDS *Demand for* PRODUCT

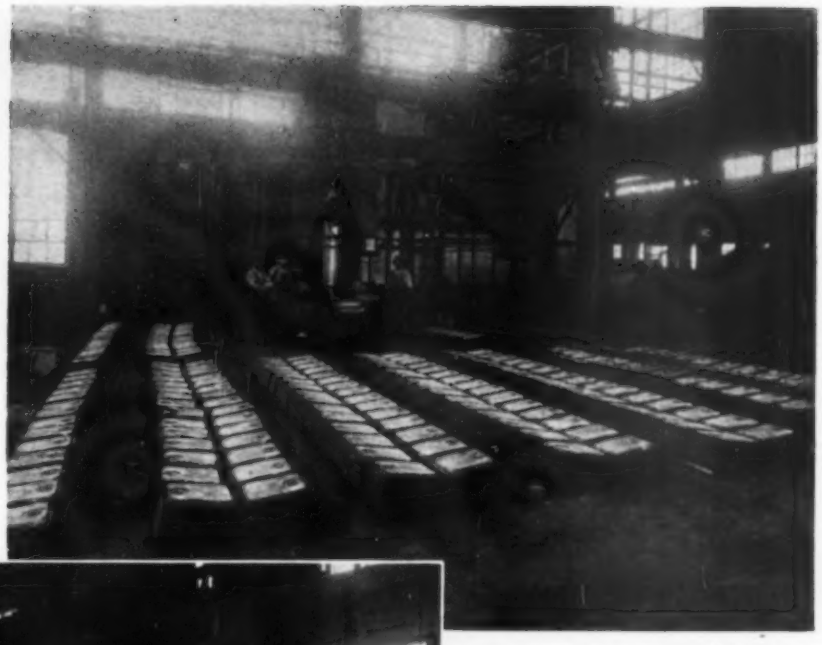


Fig. 6 (Above)—This Crew Puts Up 600 Molds Per Day

turned out, exceeds the tonnage of railroad equipment castings 3 to 1.

The guiding motive throughout and the one to which the company attributes the remarkable and steady growth of the business has been the desire to furnish castings as good, or perhaps a little better than the customer expected. Instead of side stepping a difficult job or ignoring a prospective customer noted for his promptness in rejecting castings that do not measure up to the famous soap standard, 99.44 per cent pure, the company deliberately has solicited the hard jobs and cheerfully has offered to make casting for exacting customers. Once the connection has been established even the lure of lower prices elsewhere present no attraction to many prominent customers whose national reputation is built into their product and whose monthly requirement of steel castings runs into comparatively heavy tonnage. Increased business entailed the erection of additions to the building and the installation of further equipment. Necessity of paying for these improvements suggested the advisability of taking on new accounts and the result has been an almost constant building program and a frequent realignment of the various departments and pieces of equipment.

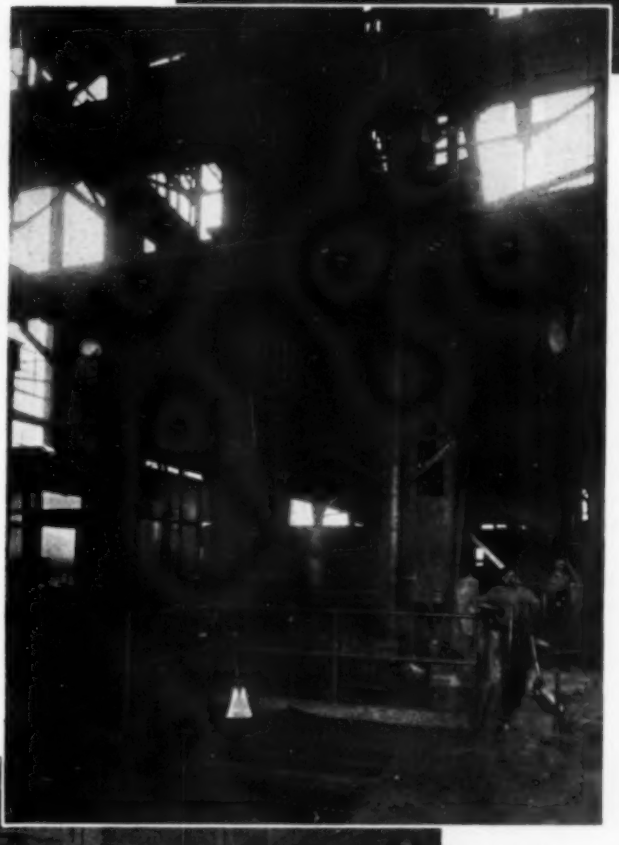


Fig. 4 (Below)—Castings Rarely Touch the Floor in the Cleaning Room. Fig. 5 (Right)—Lower Part of the Sand Preparation System

Commencing in a small space shown at the lower right in Fig. 20, the first expansion was toward the upper right. Later this part was expanded to its present dimensions and afterward part of the main building shown to the left in the same illustra-

Fig. 7—Once the Stream Starts It Does Not Stop Until the Ladle Is Emptied

tion, was erected to gain needed space.

Under the press of further congestion, early in the present year the large building shown as occupying the greater part of the left half of the illustration was erected. Another readjustment of the molding floors was made recently and to all appearance the facilities of the plant are ample to cope with present demand and anticipated logical increase for a considerable period in the future. Present plans include the early extension of the main building through and beyond the old building to the right. This extension is to serve as a cleaning room where the castings can be carried in a straight line from the shakeout floors. The present cleaning room, still broken up with partitions, will be adapted to other purposes.

The new building 107 x 370 feet, of brick, glass and steel construction occupies a corner location and is handsomely finished in gray stone on the two street sides. A three-story building adjoins the foundry on the east, or Millard street side, and houses the office, the pattern shop and pattern storage and the compressor and power station. The pattern shop is located on the ground floor, while the patterns are stored on the second and third floors served by a 10 x 10-foot automatic electric elevator made by the Haughton Elevator Co. This elevator is equipped with a safety device which prevents it from starting unless the gate is closed properly. The safety first motive is exemplified in the pattern shop where all the tools are driven by individual motors and where all the driving gear is enclosed in wire guards.

Approximately 6500 patterns are stored in this fireproof building which has been fitted with steel racks from floor to ceiling, numbered and indexed in a manner which greatly simplifies the work of marking entries and exits of the patterns. Many patterns, particularly those which are large or unwieldly are handled direct by the crane to and from a platform from the second floor of the pattern storage which extends into the foundry proper. One section of the pattern storage space is set apart for the reception of metal pattern plates used on small repetition work produced on machines.

Fig. 9—General View in the Miscellaneous Jobbing Bay, Looking Toward the Cleaning Room

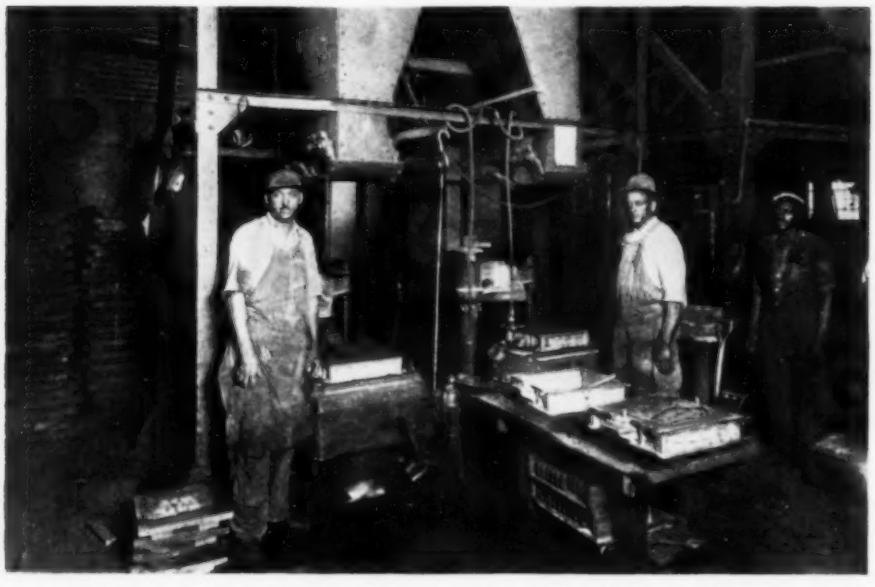


Fig. 8—Typical Installation for Small Repetition Castings

Acting on the assumption that the comfort and convenience of employes is a factor rivaling in importance the character and composition of the materials and equipment, the roof of the new building with a glass monitor extending the entire length, has been placed at a height to insure ample light and an entire absence of smoke and steam from the atmosphere. Change from the old to the new style in foundry building construction is illustrated graphically by the fact that the crane in one bay of the new section passes, when necessary, above the cranes traveling at right angles in the old section of the foundry. Eventually, as stated elsewhere, the upper runway will be extended to serve the cleaning room that at present is in contemplation.

A steam heating system is in process of installation and will be ready in ample time for the coming winter. The only occasion on which it really is needed is over the week ends. During the remainder of the week with a heat of steel poured approxi-

mately every hour, the temperature of the sand and air in the foundry is passable. Electrically cooled drinking fountains painted pure white are located at strategic points throughout the plant.

Air service pipes also are painted white, but that color is prompted by economic rather than hygienic or aesthetic motives. Compressed air carries a certain amount of oil and water in suspension and this material is deposited as a residue where air leaks through a pipe. The discoloration readily is detected on a white surface. The same general policy dictated a smooth white plaster finish on the walls of the various offices and corridors in the main office building. Discolorations may be removed easily, and discolorations of the walls are among the first and most inevitable byproducts of a system where shop and office work in close harmony.

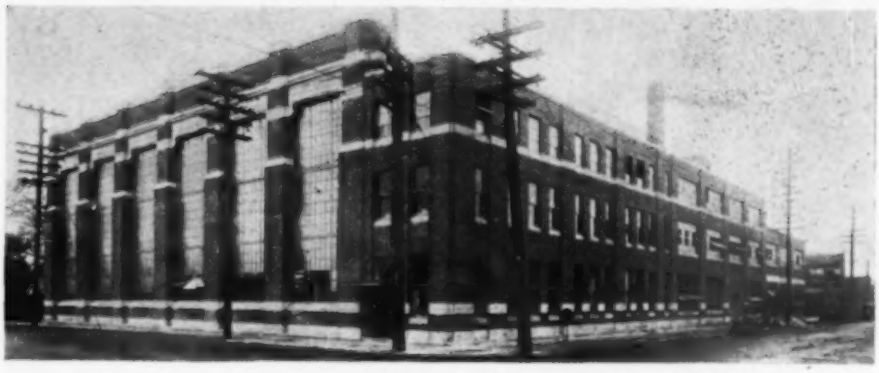


Fig. 11—Offices, Pattern Shop and Pattern Storage Occupy the Right Section of This Building

Fig. 10—Looking From the Old Toward the New Part of the Foundry While Moving Still Was Going On

The new building is divided by a row of steel columns into two main bays of equal width, 53 feet 6 inches. One bay is served by a 15-ton crane with 5-ton auxiliary hoist made by the Cleveland Crane & Engineering Co., Wickliffe, O. The other bay is spanned by a 10-ton crane made by the Harnischfeger Corp., Milwaukee.

One bay is given over entirely to the production of small castings in green sand molds made in snap flasks on a battery of jolt and squeeze molding machines erected in a row close to the west wall of the building. Four of these machines were made by Wm. H. Nicholls Co., Richmond Hill, Long Island, N. Y., four came from the Milwaukee Foundry Equipment Co., Milwaukee and the remaining ten are the product of the Johnson & Jennings Co., Cleveland. They are all set up in pairs with the drag pattern plate on one and the cope pattern plate on the other. Usually two men work a pair of machines, but in some instances a crew of four men is employed with a consequent increase in the daily output. On one typical job handled in this manner and shown in Fig. 8 the output is 600 molds per day.

Each pair of molding machines is located directly beneath a breeches sand hopper with two spouts and the molder fills his flask with sand by the simple expedient of pulling an overhead rod which actuates a gate in the bottom of the spout and releases sufficient sand to fill the flask. The hoppers in turn are loaded from a conveyor belt which extends the complete length of the new building at one side. A transverse belt extends across the end wall of the building and carries sand from the long belt to hoppers which supply six large jolt rollover molding machines (3 pairs) installed by the Herman Pneumatic Machine Co., Pittsburgh.

Molds made on these large machines are set up for pouring in the second main bay of the new foundry. At present they are lifted by the crane, but plans are well forward for placing them on roller conveyors. In addition to the molds made on the machines, a considerable number are made on the floor where the sand is rammed with pneumatic rammers. All these molds are green sand and the sand for the miscellaneous flasks is brought by crane and grab bucket from where it is discharged over the end of the molding sand conveyor belt.

Fig. 12—Castings Are Preheated in One, Held at Full Heat in the Second and Cooled in a Third Chamber of the Furnace

Fig. 13 *(Above)—Patterns Are Stored in Indexed Steel Racks. Fig.* 14*—Machines in the Pattern Shop Are Driven by Individual Motors and Are Fully Equipped With Safety Appliances*

Instead of applying a small quantity of specially treated sand to the face of the pattern and then filling the flask with *run-of-mine* material from a miscellaneous sand pile, the practice in this foundry is to treat all the sand mechanically and thus convert it into a facing sand. Equipment for preparing and distributing the sand was designed and fabricated by the National Engineering Co., Chicago.

After the molds are poured a special shakeout gang dumps them into a steel pan lifted from place to place with the crane. The castings, bands and bottom boards are removed. The castings are loaded into steel buckets while the bands and bottom boards are stacked at a point convenient for the molders. Buckets containing the castings are taken to the cleaning room in the old section of the building. The majority of castings never touch the floor of the cleaning room. They are moved from place to place on a fleet of 50 trailers. Pans containing the sand are taken to a point near the junction of the old and new foundry where the sand is dumped into a rotary crusher and thence through a grating in the floor. An elevator takes it aloft, screens it and deposits it in a large steel storage hopper. From the hopper it is fed in batches to an 8-foot diameter muller where a dry binder is incorporated in the ratio of 1 to 20. Water is added according to the discretion of the attendant in charge from a perforated pipe which encircles the mixing pan on the inside near the upper edge.

Close control is maintained over the moisture content, bond and permeability of the sand. Moisture content and bond are held to a minimum with a consequent increase in the natural permeability. Every night a definite amount of accumulated dried sand is passed through an exhaust system made by the W. W. Sly Mfg. Co., Cleveland. This treatment removes all dust and fines. The purified sand is returned to the circulating system on the following day and assists in maintaining the permea-

Fig. 15*—Small Cores Are Dried in an Electrically Heated Drawer Oven. Fig.* 16*—Large Ladles Are Heated Against a Brick Bulkhead. Small Ladles Are Inverted Over a Circular Oil-Fired Combustion Chamber*

bility at a predetermined standard. A larger sand reclaiming unit manufactured by the same firm now is in process of installation. It has a capacity of 4 to 6 tons of reclaimed sand per hour. This sand will be deposited in the sand storage hopper directly over the sand handling equipment.

Prepared green sand is discharged through a side gate in the mulling pan into an elevator which carries it aloft to a storage hopper which in turn feeds it on to the main conveyor belt referred to some time back.

Castings are made in dry sand molds in a section of the old foundry shown at the extreme upper right in Fig. 20. The facing sand is prepared from a mixture of new silica sand, silica flour and clay in the proportion of 10, 1 and 1 respectively in a grinding pan. Core sand is prepared in a third roller and pan type mixer located in the core room. Usually the cores are comparatively small and are made from new silica sand bonded with oil or with a dry binder. The larger cores are faced with a dry sand facing mixture similar to that employed in the dry sand molds. The interior is filled with old molding sand which serves the double purpose of reducing the cost of the sand and of facilitating contraction of the casting.

Molds are dried in one and cores are dried in three ovens made by the Foundry Equipment Co., Cleveland. Two of the core ovens and the mold oven constitute a battery that is oil fired. The burners are located at the end opposite the doors and the gases of combustion enter the oven through a great number of openings in the roof of a firing tunnel locatel below the oven floor level. Molds are dried on a car, while the cores are loaded on racks transported into and out

Fig. 17—Charging Pans Are Loaded and Weighed in an Alley Close to the Furnace

of the drying oven on lift-type trucks.

In line with its general policy of progress the company installed an electrically heated core oven when a new unit was required. This oven is of the drawer type made by the Foundry Equipment Co., with four drawers or shelves 42 x 72 inches and presents many interesting features in contrast to ovens that were considered highly efficient by a former generation. The drawers are carried at the front end by a patented double suspension ball bearing trolley which runs on cantilevered channel tracks. The rear ends of the drawers are carried by a frictionless differential roller arrangement which it is claimed eliminates the necessity of any kind of lubrication inside the oven. Machined bearings, rails, trolleys and the positive engagement of the drawer front at two points eliminate vibration with its consequent danger of breakage or distortion. All ovens are operated under pyrometrical control.

The same policy prompted the installation of an electrically heated annealing oven when the output of the foundry exceeded the capacity of the oil fired unit which had served with eminent satisfaction for several years. The new oven is made up of one main chamber which can be divided in two by a vertical movable bung, and a side chamber in which the castings are preheated by escaping heat from the second of the two divisions in the main chamber. In this manner practically all the heat generated by the elements attached to the walls is utilized so long as the oven is kept in operation. Loaded cars are moved through the oven and back to the cleaning room by cables attached to electrically operated capstans mounted on the floor beyond the ends of the rail switches leading to the oven.

Fig. 18—(Left)—Some of the Molds Are Dried in an Oil-Fired Oven. Fig. 19—(Above)—Certain Types of Castings Are Molded Horizontally, But Are Gated and Headed to Be Poured in a Vertical Position

Eight and sometimes nine 3-ton heats are taken daily from a 1½-ton electric furnace made by the Pittsburgh Electric Furnace Corp., Pittsburgh. Electric current for the furnace, also for operating other pieces of equipment is purchased from the

Toledo Edison Co. Graphite electrodes are employed in the furnace which operates most of the time on carbon steels. Alloy heats are made occasionally including a high manganese steel used extensively in certain types of railroad rolling stock. The carbon in this steel ranges from 0.20 to 0.30 per cent and the manganese runs from 1.20 to 1.50 per cent. Annealed at 1700 degrees Fahr., and then allowed to cool slowly this steel shows a tensile strength of 95,000-105,000 pounds per square inch and an elongation of 20 per cent in 2 inches. Other physical properties include: Yield point 60,000 to 65,000 pounds per square inch, reduction in area 36 to 40 per cent and a brinell hardness of 170 to 180.

Scrap for the charge made up largely of plate clippings is brought in from the stockyard by a magnet suspended from a monorail. The material is loaded in long pans mounted on wheels and also provided with attachments for the crane chains. Each pan load is weighed on a platform scale located a short distance from the charging door of the furnace and made by the Toledo Scale Co., Toledo, O. The nose of the loaded pan is inserted in the furnace. The rear end then is raised by the crane and the contents are spilled in the interior of the heated electric furnace.

Up to the present the melting capacity of the furnace has been sufficient on single shift to keep pace with the output on the molding floors. With the anticipated increase in production from the greatly expanded floor space the furnace will be operated one or two or perhaps more hours at night, or, if conditions warrant, it will be operated on a double shift.

Metal is melted exceedingly hot and the entire charge is tapped into a single crane ladle. The steel is poured directly over the lip of this ladle into medium and heavy weighted castings in one bay of the foundry. In the other bay the steel is poured over the lip of the ladle into hand ladles and double shanks. The ladle remains in one position and the metal is transfered rapidly by a special pouring gang to any designated collection of molds. Once the large ladle starts to pour, the stream is not stopped until the ladle is emptied. It is claimed that by the use of the individual hand ladles with a capacity of 45 pounds of metal the heat is poured faster, spillage is reduced, runner cups are eliminated and scrap losses are cut down to a remarkable extent. After the steel is poured, the pouring gang becomes the shakeout gang. Under the piece work compensation rates which have been established, a definite amount is paid for pouring each mold and another definite amount for shaking it out. The amounts are totaled each day and divided equally among the group of men.

On some heats, part of the contents of the ladle is poured in one bay and the remainder poured in the other bay. A shop kink has been developed for transferring the ladle from one bay to the other quickly and with a minimum loss of temperature in the steel. After the last hand ladle or shank has been filled in one bay the crane ladle is not tipped back to a perpendicular. It is held in a partly tipped position and lowered on to a pair of standards attached to a truck mounted on a section of roller conveyor. The crane hook is disengaged, the ladle and truck are pushed into the second bay where the ladle is picked up by the second crane with the steel in the same relative position as when the last ladle was filled in the first bay. The transfer truck was supplied by the Whiting Corp., Harvey, Ill., and the section of roller conveyor is part of an extensive roller conveyor installation supplied by the Matthews Conveyor Co., Ellwood City, Pa.

Ladles are dried and heated on a special oil fired device developed and

(*Concluded on Page* 679)

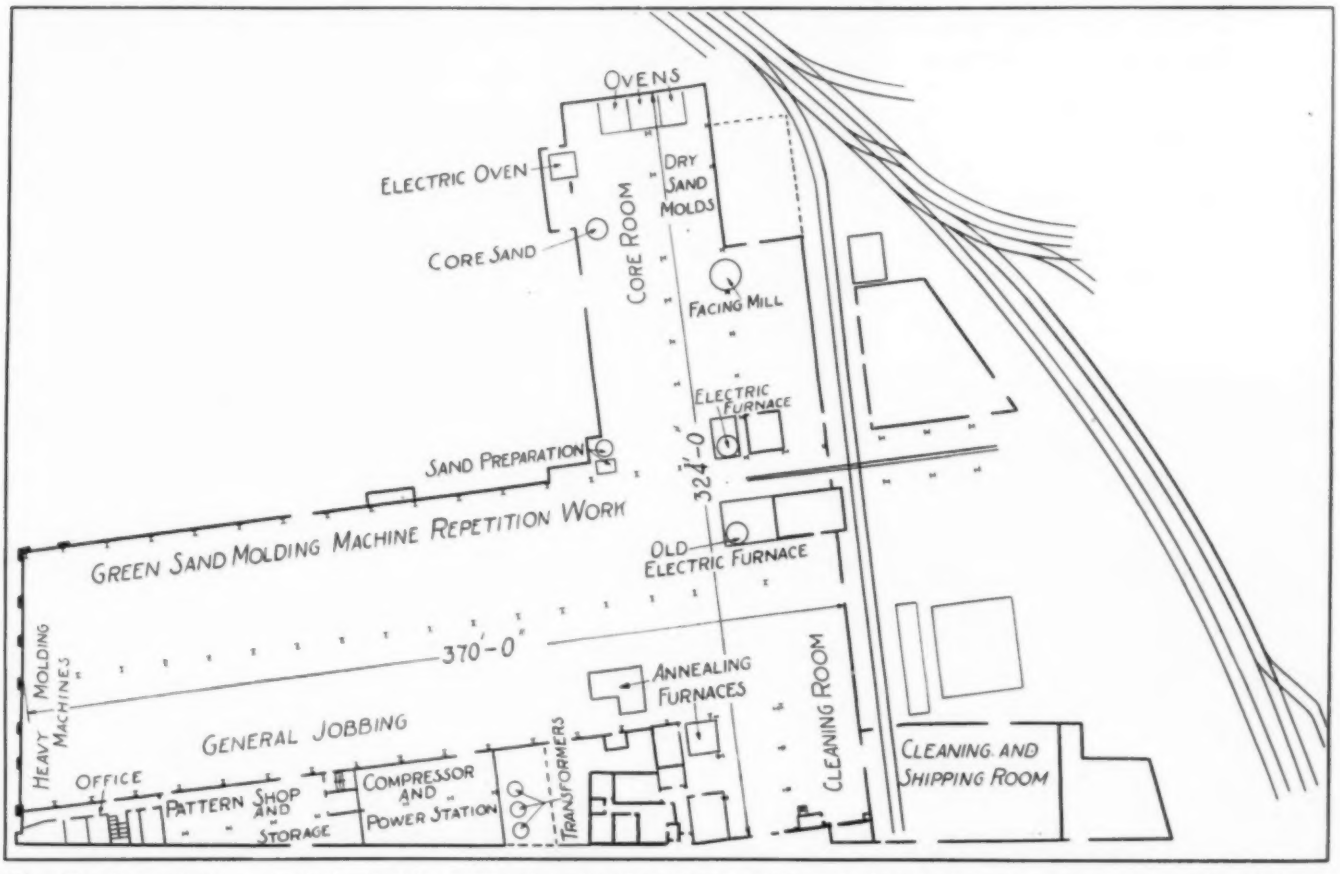


Fig. 20—General Layout of the Building, Showing the Relative Position of the Various Departments in the Old and in the New Sections of the Completed Foundry

Applies Scientific Data

To Problems Encountered in Foundry Work

Composition of the Iron, Cupola Operation, Carbon Control and Pouring Practice and Other Factors Govern the Production of Sound Castings

By Frank Hudson

THE first essential for the successful production of gray iron castings is to decide upon the analysis of the iron mixture. The practical man generally is familiar only with two mixtures, hard and soft, special and common, or some such other terminology. These may mean anything. For example, his hard mixture, assuming it is semisteel, could range from 1.0 to 2.0 per cent silicon, or contain from 5 to 90 per cent steel scrap.

There is an international need today for a term which will give some indication of the grade of semisteel most suited for different classes of work. It has been suggested by the technical press of Great Britain that the term steel-mix iron would be preferable, giving the percentage of steel in the mixture as a prefix—for example, 20 per cent steel-mix iron, etc. This suggestion is worthy of further consideration.

Today many foundries have as many as six mixtures going through the cupola in one day. The composition of the casting extensively determines its quality, freedom from defects, and future service. Considerable variation exists in the composition of the same type of castings from different foundries, according to the accepted views and technical knowledge on hand. The composition specifications shown in Table I always have been accepted as standard, have proved their practical worth time and again, and are typical of the best practice.

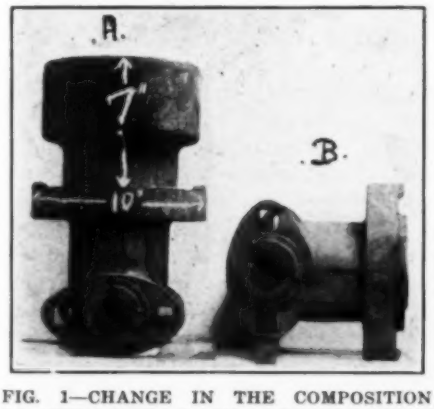


FIG. 1—CHANGE IN THE COMPOSITION OF THE METAL ELIMINATED THE HEAD SHOWN AT *A*

Exchange Ideas

IMPORTANCE of scientific data in foundry operation is emphasized in this article which is the first of two from a paper presented at the Chicago convention of the American Foundrymen's association by Frank Hudson, chief metallurgist, Glenfield & Kennedy, Kilmarnock, Scotland. The second section will appear in an early issue. The paper is the sixteenth in a series on foundry problems being exchanged between the Institute of British Foundrymen and the American Foundrymen's association. The first, prepared by the late George K. Elliott was presented at the 1921 meeting of the Institute of British Foundrymen. The second was presented at the Rochester, N. Y., meeting of the American Foundrymen's association by F. J. Cook, past president of the Institute of British Foundrymen. Professor Enrique Touceda presented the third paper before the British Society. The fourth was written by Dr. Percy Longmuir; the fifth by Major R. A. Bull; the sixth by Wesley Lambert and G. Hall; the seventh by Dr. R. J. Anderson and M. E. Boyd; the eighth by J. E. Fletcher; the ninth by Dr. H. Ries; the tenth by Arnold J. Lenz; the eleventh by John Shaw; the twelfth by Dr. J. H. Andrew; the thirteenth by J. T. MacKenzie; the fourteenth by F. A. Melmoth; the fifteenth by John Howe Hall, and this, the sixteenth paper, was presented at the 1929 meeting of the A.F.A. on behalf of the I.B.F. The seventeenth was prepared for the June, 1929, meeting of the I.B.F. by J. W. Bolton in behalf of the A.F.A.

Quality of gray iron castings generally is determined by their appearance as cast, after machining, and by the test results of the inspector's bars. This question of quality representation by test bars has given rise to a great deal of thought in the past few years to try to correlate strength with mass effect, and so obtain a better idea of the actual strength obtainable in different sections of castings. This is a most important point to the designer.

The British Engineering Standards association, in co-operation with the Cast Iron Research association, recently has issued a new specification, intended to further this matter, and suggests the use of round bars of varying sections according to the section of the casting. This is a step in the right direction, but such a specification demands of the founder a more intimate knowledge of those technical point in the composition of cast iron which give quality, and good test figures. The specification shown in Table I has been drawn up with this fact in mind, and it has been found that cast iron, having the analysis stated, will give the specified test figures. For example, a casting ½-inch thick cast in dry sand with mixture No. 1 will give approximately 11 tons (24,750 pounds) per square inch tensile, while a large hydraulic cylinder 4 inches thick cast in No.

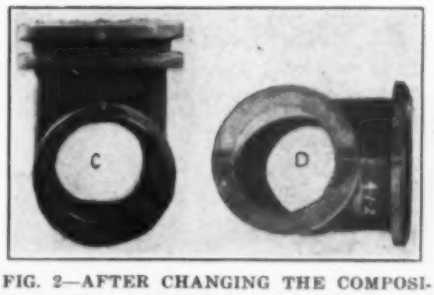


FIG. 2—AFTER CHANGING THE COMPOSITION THE CASTING WAS MOLDED ON ITS SIDE

4 mixture will likewise give 11 tons per square inch tensile, these results being obtained from test bars of varying sizes to meet the difference in casting section.

Besides bearing upon quality, the composition of the iron has an important part to play in producing castings free from defects. The defect most troublesome to the average founder is that of shrink-holes. This is of particular import when castings are subject to a pressure test, and in this respect the specification shown in Table I has been instituted through research. The composition of the irons shown therein exhibit the minimum of trouble due to this cause.

Solidity of gray iron castings is determined by several factors, metal composition, pouring temperature, method of molding, design, etc., and of these, composition has an important part to play. Especially is this the case where badly designed jobs are on hand, and it is peculiar that the more important castings, such as locomotive cylinders and valve bodies, etc., are the biggest offenders in respect to the composition of the metal.

FIG. 3—INSTRUMENTS INDICATE BLAST PRESSURE AND VOLUME

DAILY CUPOLA REPORT.

GLENFIELD & KENNEDY LIMITED, KILMARNOCK.

Date 21 Aug. 28 Blast on 10.30 A.M. Bottom Dropped 5.0 P.M.

Cupola No. A.

No. of Charges	Mixture: Material	Tons	Cwts	Qrs	Lbs	Cal. Analysis: Si.	P.	Actual Analysis: Tc.	Si.	Mn.	P.	S.	Wt. of Charge: Cwts	Wt. of Coke: Lbs.	Wt. of Limest: Lbs.	Blast: Press.	Vol.	Remarks
½	SCRAP	-	15	-	-	2.2	.40						30	334	100	18"		Run off metal
1	HEMATITE	-	7	2	-													
	SCOTCH No.3	-	7	2	-	2.0	.40						"	"	"	"	5333 cu.ft. per min.	Mixture No.1.
	SCRAP	-	15	-	-													
6½	HEMATITE	-	7	-	-													
	SCOTCH No.4	-	8	-	-	1.5	.30						"	"	"	10"		Mixture No.2.
	STEEL	-	7	-	-													
	SEMI-STEEL SCRAP		8	-	-													
30	HEMATITE	-	7	2	-			2.02	.85	1.07	3					10"		
	SCOTCH No.3	-	7	2	-	2.0	.40	2.02	.80	.29	.079		"	"	"	To		Mixture No.1.
	SCRAP	-	15	-	-			2.06	.82	.25	.069					14"		
								1.97	.77	.45	.073							
	KEEP'S SHRINKAGE TEST = .142" Per foot.																	
	TRANSVERSE TEST 1" x 2" bar on 3ft. centres = 31 Cwt.0 Qrs. 8 Lbs. with .529" defl.																	
	MATERIAL ANALYSIS.																	
	HEMATITE							4.0	2.2	1.4	.05	.06						
	SCOTCH No.3							3.4	2.4	1.0	.50	.06						
	SCOTCH No.4							3.5	1.7	1.2	.50	.06						
	SCRAP							3.3	2.0	.90	.40	.08						

MELTING RATE 9.1 TONS PER HOUR.
TEMPERATURE AT CUPOLA SPOUT = 1400 °C (OPTICAL)

Weight of Bed Coke. 1t 2 - 3 - 0
Total Iron Melted 57- 0 - 0 - 0
Total Coke Used 5-13 - 1 - 8
Total Limestone Used 1-13 - 3 -20
Coke Ratio to Iron Melted 1 :10.0

FIG. 4—SPECIMEN DAILY CUPOLA RECORD RESPONSIBLE FOR REDUCING THE VOLUME OF DEFECTIVE CASTINGS FROM 2 TO 3 PER CENT

When a casting leaks under test, and the practical man has his suspicions of the presence of porosity and shrink-holes, he either thinks the metal is too hard, or else decides to put a riser on that spot, or some sort of feeding head. Softening the metal probably will make matters worse. Extra heads and risers increase the weight of metal required for the job, and the ratio of castings produced to material melted is not so good. All this helps to keep up high oncost or overhead charges.

Fig. 1, shows a 2-inch hydraulic stop valve body for 2500 pounds per square inch test pressure. Valve A shows the general method used for molding, with a large feeding head and casting vertical with soft iron: Total carbon 3.30 per cent, silicon 2.00 per cent, manganese 0.70 per cent, phosphorus 0.60 per cent, and sulphur 0.075 per cent.

Without the feeding head castings invariably leaked on test. By altering the composition to a semisteel mixture No. 2 in Table I, and casting on the side as shown at B, Fig. 1, and dispensing with the head the resulting casting was perfectly tight on test, and possessed a much superior appearance after machining. This meant a large saving in machining time, while the removal of the head, which was 95.7 per cent of the weight of the casting, resulted in a saving of metal, and increased production. Fig. 2 illustrates a similar saving on a larger casting through the use of correct composition.

Cylinders Cause Trouble

Locomotive cylinders were a constant source of trouble due to leakage under test in the piston valve steam ports. The cause unquestionably was due to porosity, and the presence of shrink-holes through unequal sectional metal. The obvious practical solution was the use of chills or denseners, and at one time numerous chills were in use on a single cylinder. This certainly improved matters, but did not entirely cure. The average composition in use was total carbon 3.3 per cent, silicon 1.2 per cent, manganese 0.70 per cent, phosphorus 0.42 per cent, and sulphur 0.08 per cent. This was modified to total carbon 3.53 per cent, silicon 1.00 per cent, manganese 1,0 per cent, phosphorus 0.12 per cent, and sulphur 1.00 per cent, and sound cylinders were obtained without the use of a single chill. Particular mention is made of this iron in Table I, as mixture No. 3A. The average hardness of this composition runs around 212 brinell and 18 tons (40,500 pounds) per square inch tensile was obtained.

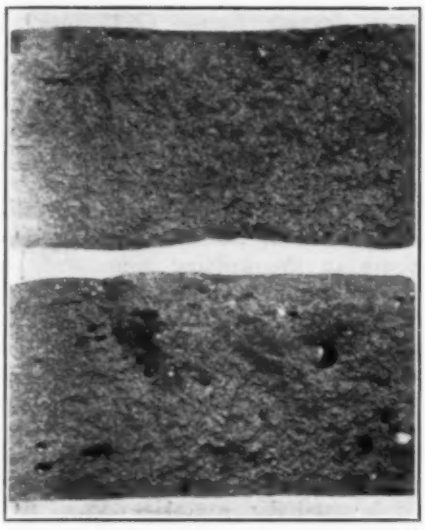


FIG. 5—BLOW HOLES IN LOWER SECTION SHOW THAT THE METAL WAS COLD

Other instances can be cited from various technical proceedings and tansactions. For instance, Smalley in the proceedings of the Institute of British Foundrymen, 1922-1923, gives examples of obtaining greater solidity in sluice valves, and the displacement of chills on unequaled sectioned metal at the valve faces, by a revision of composition. The reason for obtaining sounder castings by the use of correctly compositioned mixtures is explained by the work of Smalley, MacKenzie, Bolton, and others. Their writings upon this subject should receive greater attention. In fact, an extensive practical application of such work would do far more good to the general foundry trade than many other scientific researches published in the past few years.

Governs Setting Period

All shrink-holes and porosity are formed during the freezing or setting period of the molten iron in the casting, and the composition determines the length of this period. The softer the iron, the greater the freezing period, and the harder the iron becomes then the less is the freezing period. It is obvious that the smaller this range, the likelihood of porous castings being produced is correspondingly reduced. Casting temperature, type of mold used, molding methods, and cupola operation are all bound together for success and these will receive consideration later in the discussion.

By reducing the total carbon, silicon, phosphorus and manganese, and by increasing the sulphur, an iron with the lowest freezing period is obtained. However, this would not be good practice used indiscriminately. Trouble certainly would arise due to lack of fluidity, and hard castings would be produced. The bulk of the information on hand relative to this question suggests that the manganese and sulphur should be constant around 1.0 per cent manganese with the sulphur not exceeding 0.10 per cent, and the necessary variations made in the other elements. In the author's experience it has been found that for high class work the total carbon content should not drop below 3.0 per cent and for cylinder work, having variation in section, an increased amount of total carbon up to 3.5 per cent is desirable.

The present-day tendency for total carbon contents below 3.0 per cent is not essential for general foundry practice, and leads to difficulties. The important part total carbon plays in the solidity of castings unquestionably is hinged upon the cooling rate and casting section. With the same cooling rate and casting section an increase in the total carbon content brings about *liquid expansion*, which in conjunction with a composition of short freezing range is an invaluable help for obtaining solid castings having varying section in their design. However, the use of high total carbon mixtures and the consequent increase in graphitic carbon demands that low phosphorus contents be used to obtain satisfactory toughness and good test results.

Fluidities of the compositions shown in Table I are perfectly satisfactory, if they are used for the sections stated and consistent with good cupola practice. In drawing up this table an attempt has been made to correlate composition with casting quality as determined by strength and solidity, to provide a suitable working basis for the foundryman. At the same time, it is quite probable that the grade of material used to obtain the mixture such as quality of pig iron, percentage of scrap, etc., will cause different results to be obtained even in cast iron of a similar analysis.

Unless careful and consistent cupola operation is practiced, the values accruing from composition specifications are negligible. The melting of cast iron has been badly neglected in the past, and little real general practical progress has been made. New developments, from time to time, have been brought out which tend to perfect the working of the cupola. These should be considered carefully before adoption. A great number are old facts in disguise, and the foundryman could have applied them himself if he had tried to study the working and changes taking place within the furnace. However, some improvements, are well worth installing.

The cupola, as a furnace which nowadays has to be controlled to give definite results, is certainly a difficult proposition, yet when run under scientific lines gives wonderful uniformity for general foundry practice. Cupolas too often are managed by men, who through lack of sufficient knowledge, dare not deviate from their present practice. The essentials to

FIG. 6—CUPOLAS ARE CHARGED MECHANICALLY BY ELECTRIC HOIST AND SPECIAL DUMP BOXES

be looked for in good cupola practice may be stated as follows:

1.—Careful weighing of all materials including air.

2.—Careful analysis in conjunction with physical tests of all raw materials used.

3.—Correct fluxing.

4.—Rapid and hot melting. The molten iron should leave the furnace spout at a temperature of at least 1400 degrees Cent. (2500 degrees Fahr.). The hotter the better.

5.—The brickwork at the charging door never should exceed black or dull red heat until the last 30 minutes of blow.

6.—Correct flame at the charging door. A bluish-pink flame, clinging to every little projection and ledge in the chimney stack, now and again running down and burning at an opening in the charges.

Mechanical charging is equally as good as hand charging, and saves the double handling necessary for hand charged cupolas after the weighing operation.

The system in use by the author is shown in Fig. 6 and has proved perfectly satisfactory.

Blast control is a vital factor, and is essential for successful control. Fig. 3 illustrates a typical pressure and volume meter, and the limit marks on the volume indicating tube should be particularly noted. These are set by the laboratory, according to the best practice, and the cupola controlled by the furnaceman to give a constant figure. Constant blast pressure and volume is most important in cupola working, as this is the absolute index of a constant melting zone. In this respect another point often lost sight of is that the melting zone is fixed by the tendency of the air to travel upwards. Any disturbing factor, such as a large open slag-hole, will lower the melting zone, and possibly give dull metal. The slag-hole in cupola working should only be opened when absolutely essential, and then closed as soon as possible, or, kept open altogether.

Some years ago the author conducted a research upon the melting and casting of high duty irons, and an investigation into the changes taking place inside the cupola, and obtained the conclusions that three distinct zones existed in which the following changes occurred:

Zone 1.—Extending from the charging door sill down to beginning of melting zone. For practical purposes cast iron and steel mixtures in this zone absorbs no extra carbon until actual melting begins.

Zone 2.—The actual melting zone. Cast iron and steel melt just above the hottest zone at their respective melting temperatures, and fall through the hottest zone in small drops, this zone having a temperature of at least 1650 degrees Cent. (2940 degrees Fahr.), which is amply sufficient to superheat these small drops. Carbon absorption now takes place rapidly, due to high temperature, and intimate contact with incandescent coke.

The degree of carbon absorption depends upon the prevailing atmosphere in the melting zone, and the composition of the material being melted, together with time and temperature in the melting zone. The higher the temperature the more carbon will be absorbed in a certain time, according to the facility of applying free carbon and the re-activity of the coke structure. The absorption is lowered by excessive blast with the consequent production of an oxidizing atmosphere, and material containing a low carbon content such as wrought iron or steel probably will not pick up as much carbon as cast iron. All cast iron material is superheated in the true sense of the term superheat, while wrought iron and steel are not superheated in the true sense of the word, but by melting at a high temperature and solidifying at a much lower temperature obtain a superheat greater than the cast iron material.

Zone 3.—Extending from the melting zone to the well. The molten metal lying in the hearth or well falls in temperature, and in the case of cast iron material probably loses carbon. Steel charges still may, however, absorb further carbon, according to the degree of carbon absorption obtained when passing through the melting zone. Sulphur is absorbed in the two lower zones.

Total Carbon Control

At present total carbon control in the iron foundry is a difficult matter, and likely to become of extreme future importance in the development of high test material either through the use of alloy additions or by modified melting practice. The original carbon content of the material has little bearing upon the final carbon content after melting, and cupola control is the key to this matter.

For general high duty castings using varying quantities of steel in the mixture, and giving a minimum of 3.0 per cent total carbon after melting, the aim should be to have the correct amount of air to combine with the coke to give a neutral or slightly oxidizing atmosphere. The lower the blast pressure, consistent with correct volume, the hotter is the metal obtained, due to a lower melting zone and hotter hearth.

High total carbon irons melt hot, but slowly. The melting point of

Table I

Gray Cast Iron Mixture Specifications

No.	T. C.	Si.	Mn.	P.	S.
I	3.5*	1.8 to 2.1	1	0.2 to 0.4	0.09†

Ordinary Metal: For low and medium pressure castings made in green sand not over 1-inch section, low pressure castings in dry sand up to 1-inch section, structural work up to 1½ inches thick and general castings with no test specified.

Typical Applications: Pipes, light sluice valve bodies up to 24 inches, medium valve bodies up to 10 inches, heavy valve bodies up to 6 inches, extra heavy valve bodies up to 5 inches, general machinery castings, condenser and turbine castings, automobile cylinders, light and medium bed plates etc.

No.	T. C.	Si.	Mn.	P.	S.
II	3.3*	1.5 to 1.8	1	0.2 to 0.4	0.09†

Soft Semisteel: For low and medium pressure castings made in green sand between 1-inch and 1½-inch section, low and medium pressure castings made in dry sand up to 1½-inch section, heavy structural work and low pressure castings up to 2 inches thick.

Typical Applications: Heavy bed-plates or sole-plates, light sluice valve bodies above 24 inches, medium valve bodies above 10 inches, heavy valve bodies above 6 inches, extra heavy valve bodies above 5 inches, hydraulic pipes, low and intermediate marine engine cylinders, etc.

No.	T. C.	Si.	Mn.	P.	S.
III	3*	1 to 1.2	1	0.2†	0.10†
IIIA	3.5*	1 to 1.2	1	0.2†	0.10†

Semisteel: For high pressure castings over 1½ inches thick.

Typical Applications: Hydraulic rams and cylinders not over 3-inch section, hydraulic valves, steam and pump cylinders, locomotive cylinders, high pressure valves over 2-inch section. Reciprocating or bearing engine parts in metal to metal contact. For cylinder work having unequal sections use mixture No. 3A.

No.	T. C.	Si.	Mn.	P.	S.
IV	3*	0.6 to 1	1	0.2†	0.10†

Hard Semisteel: For hard wearing castings, heat resisting work and exceptionally thick high pressure work.

Typical Applications: Hydraulic rams and cylinders over 3-inch wall thickness, heat resisting gas reversing valve tongues, ingot molds, bearing sleeves and races, castings for handling ammonia at high pressures.

*Approx. †Max.

NOTE: If castings are authorized to be cast with metal other than stated here, raise a query.

the materials used has quite an appreciable effect upon the resulting temperature obtained, and in the author's opinion this point has quite a bearing upon the preference for sand cast instead of machine cast pig. It is suggested that the combined carbon figure determines the actual melting point.

In conjunction with the need of cupola control for obtaining the correct total carbon contents, the important part played by the coke must not be forgotten. McKenzie has shown that different degrees of carburization can be obtained according to the structure, and physical properties exhibited by the coke used for melting, and this is further accentuated in the Corsalli process used for obtaining high test cast irons where the reactivity of the coke is diminished by immersion in a lime sludge, and an oxidizing atmosphere obtained during melting by increased blast. This produces extremely low total carbons.

In melting cast iron for quality castings the following points should be remembered:

1.—The bed coke should be measured by volume, and the charged coke by weight.

2.—The metal mixture should be of uniform size. Too small and thin bulky material produces oxidized metal, while large thick sections produce cold metal.

3.—Every care should be taken to keep a constant melting zone, influenced by the presence and volume of blast used.

4.—Proper fluxing, using a slightly basic slag, together with hot melting, will keep the sulphur low. (This can be obtained by the use of a small amount of manganese ore with the limestone.)

5.—Careful attention to the small points.

6.—Hot melting is essential for good work.

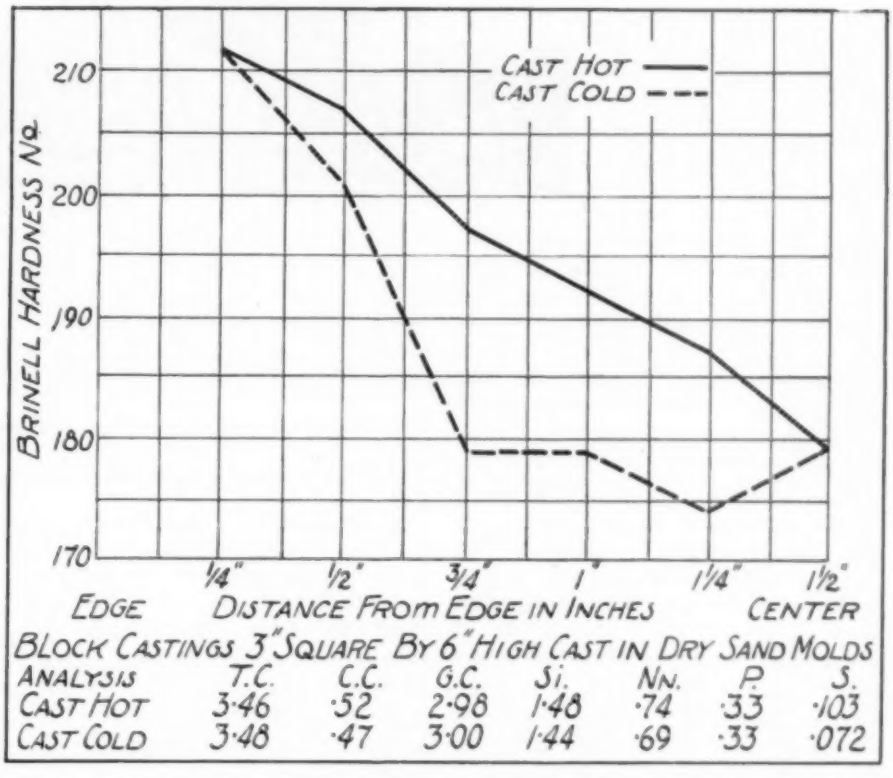
The author prefers to use a synthetic cold blast iron, containing at least 10 per cent steel scrap, made in a cupola or open-hearth furnace. This is remelted with siliceous hematite (5 per cent silicon) and a slight percentage of steel and domestic scrap added for cylinder work. In all pressure castings with variation in section, over 15 per cent of steel scrap is never added directly to the mixture without remelting, although the final mixture may actually contain well over 50 per cent steel scrap in the remelted condition. This is usually done to obtain a total carbon content of approximately 3.5 per cent as low total carbon iron is not recmmended for work other than perfectly uniform sections of metal.

Fig. 4 illustrates a specimen daily cupola record showing the control that should always be the practice in progressive foundries. In the author's own works this system has resulted in a saving of between 2 to 3 per cent in defective work.

All high duty work should be poured hot. Pouring hot is essential, whether the casting be large or small, thick or thin, if the best work is to be turned out. Lack of density in castings is due to casting at too low a temperature. This lack of density is due to either blow or shrink holes.

In large castings foundrymen as a rule often have a certain fear of casting hot. That this is a fallacy was brought home in the author's experience some time ago. A diesel engine flywheel, of about 12 tons weight and 36-inch section, had been cast on the cold side and was badly drawn under the risers. Prior to this, one had been cast successfully at a higher temperature. The first wheel had taken about 6 or 7 hours to feed, while the second had only taken about 5 hours. Obviously the faulty wheel had taken less metal, and had a lower density. If it had been cast hotter, the casting would have ben sound. Fig. 7 illustrates the uniformity or hardness through a 3-inch thick section at ¼-inch spaces from edge to center when cast hot and cold. The uniformity unquestionably lies with the hot cast section.

Fig. 5 shows the sections when fractured, and the blow holes shown in the cold cast section are generally, for semisteel at any rate, a sure sign that the metal has been cast cold. The casting temperature for general cylinder and high duty work should be between 1350 to 1400 degrees Cent. (2400 to 2490 degrees Fahr.).



BLOCK CASTINGS 3" SQUARE BY 6" HIGH CAST IN DRY SAND MOLDS

ANALYSIS	T.C.	C.C.	G.C.	Si.	Mn.	P.	S.
CAST HOT	3·46	·52	2·98	1·48	·74	·33	·103
CAST COLD	3·48	·47	3·00	1·44	·69	·33	·072

FIG. 7—DIFFERENCE IN UNIFORMITY OF HARDNESS BETWEEN IRON THAT IS CAST HOT AND COLD

Connecticut Group Holds Election of Officers

Carl S. Neumann, Union Mfg. Co., New Britain, Conn., formerly secretary of the Connecticut Foundrymen's association, has been elected president of that group for the ensuing year.

Other officers recently elected are: Vice president, Burton W. Spencer, Bradley & Hubbard Mfg. Co., Meriden, Conn.; secretary, Charles S. Parker, Charles Parker Co., Meriden, Conn.; treasurer, George R. Holmes, McLagon Foundry Co., New Haven, Conn. The board of managers is comprised of the officers and the following: H. B. Browne, McLagon Foundry Co., New Haven, Conn.; J. D. Coltman, Bullard Machine Tool Co., Bridgeport, Conn.; W. J. Maton, Waterbury Farrell Foundry & Machine Co.; Waterbury, Conn.; G. A. Ray, Taylor & Fenn, Hartford, Conn.; H. S. Washburn, Plainville Castings Co., Plainville, Conn.

Producing Steel Castings in the Modern Foundry

Part V

By Charles W. Veach

AFTER a charge is selected, as described previously in Part IV, the next step is to establish the best method of charging and make this standard practice. Unless some definite procedure is demanded, furnace operators will charge heats according to their individual ideas. While the initiative of the operators should not be destroyed, it is desirable that any changes in practice should have the approval of the department head before they are put into effect.

It is obvious that charging about 16 per cent scrap on the bottom before the limestone is charged precludes a considerable amount of iron oxide being formed through development of a protective atmosphere of CO_2 gas given up by the stone when calcining takes place. The more completely the limestone is covered by the scrap, the more effectively will the CO_2 be trapped, and remain longer in contact with the white hot metal which covers it. After the first round of scrap is charged it should be brought to a white heat so that when the limestone is charged, it will flatten the scrap, and the stone will not lie too high in the bath.

Use Rail or Spring Scrap

Rails or springs are best for covering the bottom because of the ease with which they spread, and because of their uniformity. The chemical analyses of rails and springs can be approximated more closely than any other class of scrap. Because of their carbon and manganese content they are less difficult to melt than low carbon grades.

It takes about 25 minutes to heat the high carbon scrap suitably to admit the limestone, and, the remainder should be deferred long enough to permit heating the limestone sufficiently to effect some calcining. If the limestone is covered immediately with scrap which packs closely the CO_2 will be trapped when calcination begins, resulting in a too violent boil, and may be the cause of more oxidation than is provided for in the charge. However, if a considerable part of the scrap consists of large pieces, the preheat given the limestone may be reduced or omitted, depending on how much carbon the charge contains, and whether the furnace is working sharply at the time.

Describes Operations

CHARGING the furnace is an important operation in the steel foundry if the best results are expected. Melting down, refining the heat and the operation of the furnace during these periods also must be conducted carefully if a good product is desired. These procedures are described in this article which is the fifth of a series on the production of steel castings in the modern foundry.

Usually only a part of the scrap will be charged at once, for even if the furnace would hold it all, it would be piled so high that the flame would rake the roof and walls. Dividing the charge of scrap into two cuts does not prolong the time of charging, and by doing so the flame can be kept under better control. Also, the chance of doing injury to the door jambs and arches is lessened by making two cuts of the scrap charge.

The question of how far to melt the scrap down before the pig iron is charged is viewed differently by nearly all operators. The author charges the pig when the scrap is melted low enough so that the charging pans containing the pig iron will just clear the white hot mass of metal, and permit the iron to be distributed evenly so that the low carbon material will be completely covered. The argument has been brought forward that to melt this low results in pools of liquid metal forming, which are frozen when the cold iron comes in contact with them, and must be melted again. These objectors claim that freezing this metal results in a waste of the fuel which is required to remelt it. Since the heat energy contained in the melted metal is transferred to the pig iron, the author fails to recognize a loss in its solidifying. Of course, running too long on unprotected low carbon metal may result in forming an excess of iron oxide. In addition to having a heat which has a deficiency of carbon when melted, the over-oxidized metal causes endothermic actions later in the operation which result in an excessive use of fuel. Also, when the action in the bath is endothermic a hot and voluminous flame must be maintained before any gain in metal temperature can be brought about. If there is not sufficient stirring action in the slag the furnace roof will run hot while only a small amount of heat is being transferred from the flame to the metal. If this does not result in damage to the brick lining, it at least results in a great waste of fuel.

Charging Requires 2 Hours

Time consumed in charging a 30 ton heat is usually 2 hours. From the time the pig iron is charged to completion of melting is from 2½ to 3 hours. If 6¾ hours from starting to charge to tapping is considered standard time of heats, from 1¾ to 2¼ hours will constitute the time of working the heats. The latter interval is looked upon as the refining period. However, the refining period is of longer duration than the time usually indicated. It extends well back into the melting period as we shall have occasion to point out a little later.

With heats melting uniformly in carbon, having just the desired excess of this element to work the heat properly, and having a uniform residual of manganese, the working period

indicated is ample to bring both slag and metal to any high standard condition which may be set. The sequences as given are important, and must be maintained without any undue overlapping if the heats are to be made on schedule time, and a uniform product obtained.

Uniform product means one which shows only a slight variation in manganese, silicon, carbon, sulphur, and phosphorus. Definite amounts of the first three must be present to confer the properties desired in the product, and to insure its freedom from occluded gases. The last two should be as low as the process will permit. It is to the advantage of the manufacturer of steel castings to keep these elements low as loss from cracked castings will be reduced greatly. Furthermore, practices which result in low sulphur and phosphorus in the product presupposes that other requirements have been met which influence the quality of the metal and, perhaps, the economy of the operation.

Knowledge Is Required

It is erroneous to suppose that little or no knowledge of a technical nature is required in the control of the first two stages of the heat, that is, charging and melting down. This is particularly true when heats of uniform metal must be tapped regularly to maintain a continuous cycle, as in quantity production. A heat carelessly charged and neglected during the melting operation may challenge the skill of the operator when it comes time to shape up the slag, and get the metal in condition to tap.

During the charging and melting period greater flame volume is maintained than is required during the working period. During the former period more heat is wasted by passing up the stack than occurs while the heat is being worked. If the judgment of the operator is relied upon to control the flame volume, and he must watch a clock to gage his reversals, this discrepancy will be greater than it would be if means were provided to indicate the time for reversal of the flame, and record the reversals when made. In addition to relieving the operator of the task of watching the clock his interest is stimulated because of the fact that a record is being made of his work. Pride in his work causes him to want this record as nearly perfect as he can make it.

Through saving fuel, better control of the flame lessens wear of the furnace lining, particularly on the walls near the end of the furnace, the bulkheads, and the downtakes. Also, with recording instruments installed to control the temperature of the outgoing gases, the checkerworker suffers less from excessive heat. Moreover, instruments properly installed make it possible to maintain a balanced condition of heat throughout the furnace, which effects the efficiency of the unit, has an important influence on the life of the refractories, on properly maintaining the sequences of the operation, and, therefore, helps to attain quality in the product.

Heat Balance Changes

Few realize how quickly an open-hearth furnace will become unbalanced in the heat condition of the checkers and flues, or to what degree such a condition affects the efficiency of the furnace. After only an hour or two one set of checkers and flues may be several hundred degrees hotter than the others. It is obvious that the air coming to the combustion chamber through the checkers and flues which have cooled off unduly, will have a depressing effect on the flame temperature. Without means of determining the temperature condition an unequal temperature may prevail throughout the heat period.

In the past it was customary to reverse the direction of the flame every 20 minutes while charging and melting the heat. Then when the lime had come up and covered the bath the intervals of reversal were shortened to about 10 or 15 minutes. While this approximates the present custom, no set rule prevailed anywhere to enforce reversal of flame at stipulated intervals, nor was any such rule in force within any one organization. Within limits it was left to the discretion of each operator when he should reverse his flame, and the volume of flame he should carry. Nor was it possible until recently to check the intervals of reversal with any degree of accuracy. Oftentimes the flame was kept on one end of the furnace for nearly an hour, overheating the checkers at the outgoing side, while those on the side where the air was coming in were cooled to a corresponding degree. The amount of fuel thus wasted as well as damage done to the furnace lining if known, would be surprising.

Such conditions will not occur when recording instruments are installed to check up on the operator's work. The operators are the first to welcome recording instruments because they soon realize that the instruments assist them in performing their duties intelligently and efficiently.

The operator has little to do except reverse his furnace on time, and see that the flame volume is correct, from the time the pig iron is charged until melting is almost complete, and the lime coming up quite covers the bath. However, this is the crucial period of the heat, for the lime being in a semi-liquid, pasty state, has a tendency to reflect the heat rather than conduct it to the metal below. Unless the flame is adjusted to suit the condition of increasingly heavy lime, the furnace refractories will suffer. If the operator reduces his flame volume too much the operation will be prolonged, resulting in lost time which may be regained only with difficulty, and which may interpret the cycle of operation in other departments.

However, the flame volume is not reduced during the last stages of the melting operation simply because the condition of the lime demands it. Oftentimes it is found expedient to reduce greatly both the temperature and volume of the flame to prevent undue temperature rise while the metal is still working on lime. This is occasioned when the lime dissolves as fast as it comes to the surface, resulting in what is called an open slag. On the one hand, a heavy and viscous condition of the slag demands that care be exercised in control of the flame lest the furnace refractories be damaged. On the other hand an open slag transmits the heat energy of the flame to the metal underneath it at a rapid rate. The slag in turn soon becomes hot. A hot condition of metal and slag makes it next to impossible to eliminate phosphorus when the carbon is high.

Depends on Phosphorus Condition

Even when a heat has been worked with care while preparing it for tapping, it may not be in the best of condition owing to neglect during the period of charging and melting. The author believes that 0.03 per cent phosphorus resulting from the causes described, is more detrimental than twice that amount when added in the form of ferrophosphorus to a heat which has had all the phosphorus removed during the working period. The same holds true of sulphur. Much discussion during recent years has dealt with the question of the effect of sulphur on the properties of steel. As it relates to steel castings, it concerns the manufacturer more than it concerns the consumer.

In the author's opinion the small amount of sulphur found in steel made from selected stock is too insignificant to have any influence on the physical properties of the metal. However, when the steel foundry, us-

ing the basic open-hearth process, uses raw materials of such character that the sulphur and phosphorus increase in amount, though both remain well under the maximum allowed in the specifications, trouble with fine hair-line checks begins to appear, and as the condition causes an increasing amount of one or both of these elements in the product, the nearly invisible checks become open cracks, obvious to cursory inspection.

Conditions as the above, growing out of indifference to preventative measures, cannot be obviated by skillful handling of the heat during the working period. What is done to correct an undesirable condition is never as effective as a lesser amount of effort to safeguard against it. The loss sustained by loose practice in a steel foundry is not all accounted for by the number of rejected castings, but where practices have been improved, the percentages of rejections to product accepted by the customer have been reduced greatly. It is profitable to remove the primary causes of undesirable conditions, then establish rules which prevent the practical details from being wrongly applied.

Gives Carbon and Manganese

Barring accidents all heats when melted should contain carbon within the range of 0.60 to 0.80 per cent. The residual manganese should not vary more than about 0.09 per cent from heat to heat with the same charge, and may vary less. What the residual manganese is to be depends first, on the amount of manganese in the pig iron, second, on the percentage of pig to scrap, and third, on the character of the scrap charge. As iron oxide is the chief agency by which manganese is removed from the bath, the amount of rust that is carried into the bath by the charge is a factor in governing the residual manganese the bath will contain when melting is complete. The available carbon is also a factor helping to determine what the residual manganese will be, for a bath depleted in carbon also will be depleted in manganese. For quality in the product, occasional melts low in carbon and manganese must be avoided. To avoid melts with an excessive amount of these elements, which require the use of a corresponding excess of iron ore consuming time and fuel, care must be exercised in the choice of raw materials; scrap and pig iron.

While it is true that all of the changes brought about while working the heats are not physical, they are predominantly so. Yet this is looked upon by many as the refining period. True, the slag undergoes some chemical change while it is passing from the pasty, semiliquid state to the creamy consistency desired. However, the bulk of chemical change in its ingredients takes place during calcination of the lime, a little later when lime and magnesia combine with the silicon dioxide formed by the union of silicon and iron oxide, and also by forming calcium phosphate and calcium sulphate, all taking place before or against the time melting is complete.

The change in the slag from a lumpy, viscous condition to one of liquid is brought about largely by increasing the temperature. The temperature at which the slag attains this condition depends entirely on the composition of the mass. If the slag is predominantly basic matter, its free running temperature is high. Also, if it is predominantly acid its free running temperature is high. For calcium oxide alone melts at 1995 degrees Cent., and silica alone is almost as difficult to melt. However, being compounds of several ingredients, both basic and acid open-hearth slags are subject to control. This control is one of the prime factors of making steel by the open-hearth processes.

If the slag is viscous at the time the first carbon test is withdrawn, allowances must be made for iron held in suspension in the lime and exposed to the furnace atmosphere. This serves as an estimate of the iron oxide contained in the slag, which will be available for oxidizing the carbon when the slag becomes liquid. This is another critical phase of the operation, and the operator's ability to judge the general condition of the bath by a study of the slag at this stage may be taken as a measure of his efficiency. It also reflects the amount of care with which he has been instructed in the technical phase of his work.

Adding Ore to the Heat

If both the test specimen and the appearance of the bath conditions seem to justify the use of iron ore, it should be the aim of the operator to add a sufficient amount so that no further additions will be necessary. It requires about 30 minutes for the ore to work its way through the slag. At the end of this time the amount of carbon lost by the bath usually is in excess of what would be expected to be removed by the oxygen contained in the ore. Some of it no doubt is removed by FeO (iron oxide) already dissolved in the iron, and some is removed by iron oxide given up by the slag, not from the ore added but as a consequence of its action on the slag. The ore confers fluidity on the slag and the iron oxide held in suspension or loose combination, perhaps both, becomes available to the metal bath partly by gravity and partly because of the more intimate mixing of slag and metal.

At the conclusion of the action caused by the ore about 0.45 to 0.50 per cent carbon remains in the metal. The stage of the heat which demands constant attention from the furnace operator now is entered. A little earlier the lime boil occurred, a period during which the metal boils turbulently. This turbulence is caused by the CO_2 emanating from the calcining limestone, hence the term lime-boil. During the period of the lime-boil, or the melting period, the duties of the operator are such that he can relax. After the bath becomes well covered with lumpy and inactive lime the operator must be alert lest he do damage to the furnace refractories.

Carbon Boil Begins

When the action of the ore has ceased, and the carbon has come down to about 0.45 per cent the basic slag will be too heavy to permit the carbon monoxide gas which forms in the metal to escape freely. As a consequence a frothy condition is set up. Adding fluorspar sparingly will thin the slag, and soon there is a uniform boil over the surface of the bath. Among furnace operators this action is called the *carbon boil*, and is due to the carbon monoxide gas escaping. If the action is not hindered by a viscous slag, and if no froth appears, the heat from the flame will be transfered to the metal at a high rate, and the furnace will not become dangerously hot. If the slag is not thinned out, or if a frothing condition sets in, the furnace lining may become too hot in a short time. The thing to do is to watch conditions closely throughout this critical period.

However, it is not to safeguard the furnace refractories alone that the operator must keep in close touch with the changing condition of his heat. It is important for the operator to follow his heat closely and note each change as it occurs. For it is only by so doing that all heats may be expected to come up to a high standard of quality.

No iron ore should be added to a heat within less than an hour of the time the heat is tapped. In fact if a standard condition is set to which each heat must be brought before tapping, an hour is required to bring

(*Concluded on Page* 673)

AUTO SHOP Applies Hot Blast Cupola

By Pat Dwyer

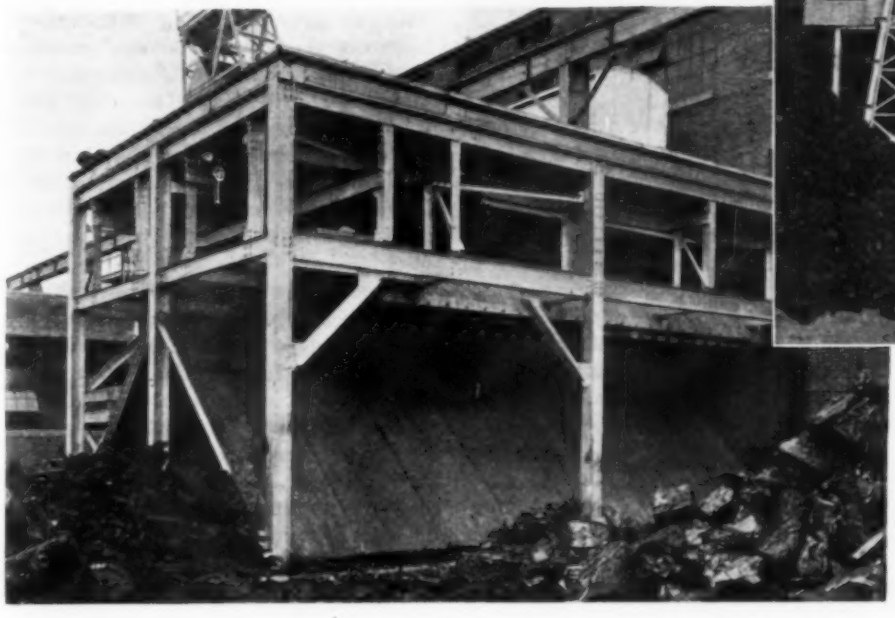


Fig. 1 (Left)—Elevated Conveyors Carry the Pig Iron and Scrap From the Stockyard to the Charging Buckets Inside the Building. Conveyors Are Loaded by Crane and Magnet. Fig. 2—(Above)—Coke Is Lifted in a Skip Hoist and Stored in a Circular Tank With a Capacity of Four Car Loads

PROSPECT of saving a considerable amount in operating expense led the management of the new foundry erected recently by the Oakland Motor Car Co., Pontiac, Mich., to modify certain methods and introduce some radical departures from what has come to be considered standardized practice in foundries devoted to the production of castings for automobile engines.

The most noticeable of these changes have been applied in the melting department where the pig iron and scrap are brought from the yard on conveyors and loaded into charging buckets, where the coke is stored in an immense hopper, where only one man is needed on the charging floor and where the blast is heated before it enters the cupola.

So far as published records show, this is the first instance of the application of a preheated blast in a foundry of this kind, but from the results attained to the present it seems that the hot blast is as applicable to a cupola melting iron for automobile engine castings as it has proved in cupolas melting iron for car wheels.

Under present limited operating conditions the saving in coke alone is given as 3 tons per day. Eventually when the foundry is melting to capacity the anticipated saving will amount to 12 tons a day. At current prices that represents $120 per day. Indirect saving to a considerable extent is secured from a lowered blast pressure—9 ounces instead of the usual 14—and increased melting speed.

Iron is melted in four cupolas erected by the Whiting Corp., Harvey, Ill. in a row at the south end of the foundry building. They are designed to be operated in pairs continuously on alternate days. Each 90-inch shell carries a single brick lining above the charging door. This is increased to give a diameter of 66 inches from the charging door down to a point about 5 feet above the tuyeres. From this point the lining gradually contracts the diameter to 60 inches immediately above the tuyeres. Each cupola is equipped with a roof hood and spark arrester.

One hot blast heater was designed and the erection supervised by the Griffin Engineering Co., Chicago. The device was fabricated and erected by the Whiting Corp., Harvey, Ill., in connection with two of the four cupolas. Blast for all the cupolas is supplied by three blowers connected to a common header and after passing through the preheating chamber may be directed into either one. All three of the positive pressure type made by P. H. & F. M. Roots Co., Connersville, Ind., are mounted with General Electric Co., motors on a mezzanine floor directly back of the cupolas and under the charging floor. Each motor is connected to a blower through a reduction gearing made by the Falk Co., Milwaukee.

The device employed for heating the blast is made up of a combustion chamber, a tube compartment and a gas chamber at the top, and occupies a space between two cupolas 5 feet 2 inches wide, 18 feet high and 15 feet 6 inches long. The tube chamber contains 224 special cast iron tubes 3 9/16-inches inside diameter, 8 feet 2¼ inches in length. Gas from the cupola is drawn into the chamber located just below the charging floor and passes through a suitable flue to

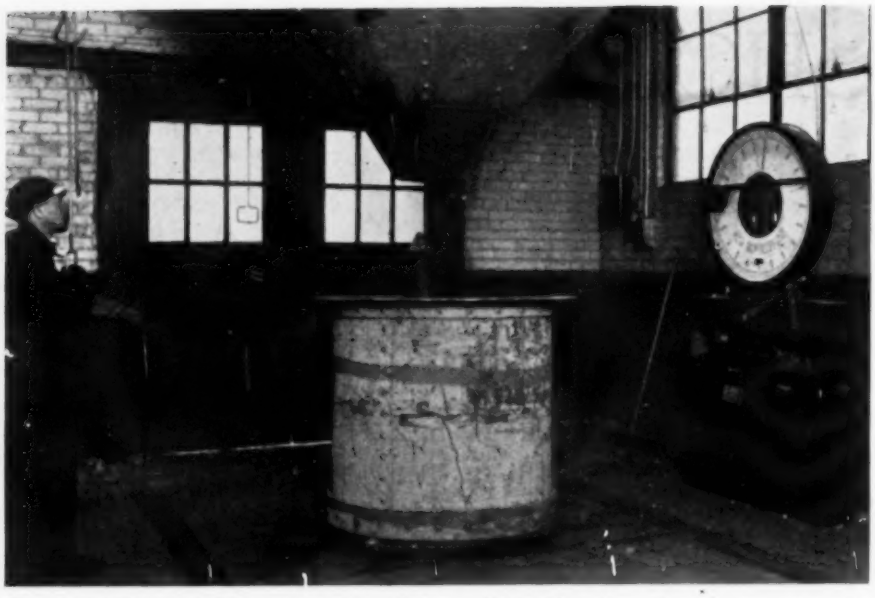


Fig. 3—Coke and Limestone Stored in a Five-Chamber Tank Fall Into the Charging Buckets by Gravity

the combustion chamber where it is ignited and from which it passes up through the maze of tubes. The blast passing between these tubes is raised to a temperature of 420 degrees Fahr.

As a result of installing this device it is claimed the iron charges have been raised from 3000 to 4000 pounds. The coke ratio has been reduced from 1 to 8 to 1 to 10. Blast pressure has been lowered from 14 to 9 ounces and the melting speed has been raised from 12 to 14 tons per hour. Iron is tapped at an average temperature of 2766 degrees Fahr. Tests have shown that the temperature of the gas at the charging door is 250 degrees, gases of combustion enter the tubes at 1550 to 1600 degrees and pass out at a temperature of 690 degrees Fahr.

Method and equipment for handling the cupola coke and limestone differ from any so far installed for the purpose. Incoming coke is discharged through the bottom of the railroad cars into a large steel and concrete hopper below the track. A skip hoist carries the coke to the top of an adjoining tower. The bucket on the skip trips a lever near the bottom of its travel limit and releases a steel door on the bottom of the coke bin under the track. The weight of coke in the bucket depresses a second lever which closes the gate in the bin. The same movement throws a switch which starts the bucket on the upward journey. At the top of the tower the coke is screened. Fine material falls into a round tank terminating at the bottom in a long pipe equipped with a valve or gate. At periodic intervals the gate is opened and the coke breeze, fines and dust are removed with a truck. The installation was made by the C. O. Bartlett & Snow Co., Cleveland and the skip feature resembles that in the unit erected by the same company two years ago for the Buick Motor Co., at Flint, Mich.

Screened coke falls into a large steel circular tank with a capacity of four carloads of coke and one carload of limestone. The tank is divided into four sections by partition plates which reinforce the interior and also support a circular, upright pocket in the center. Coke from above may be deflected into any one of the four pockets while the limestone is directed

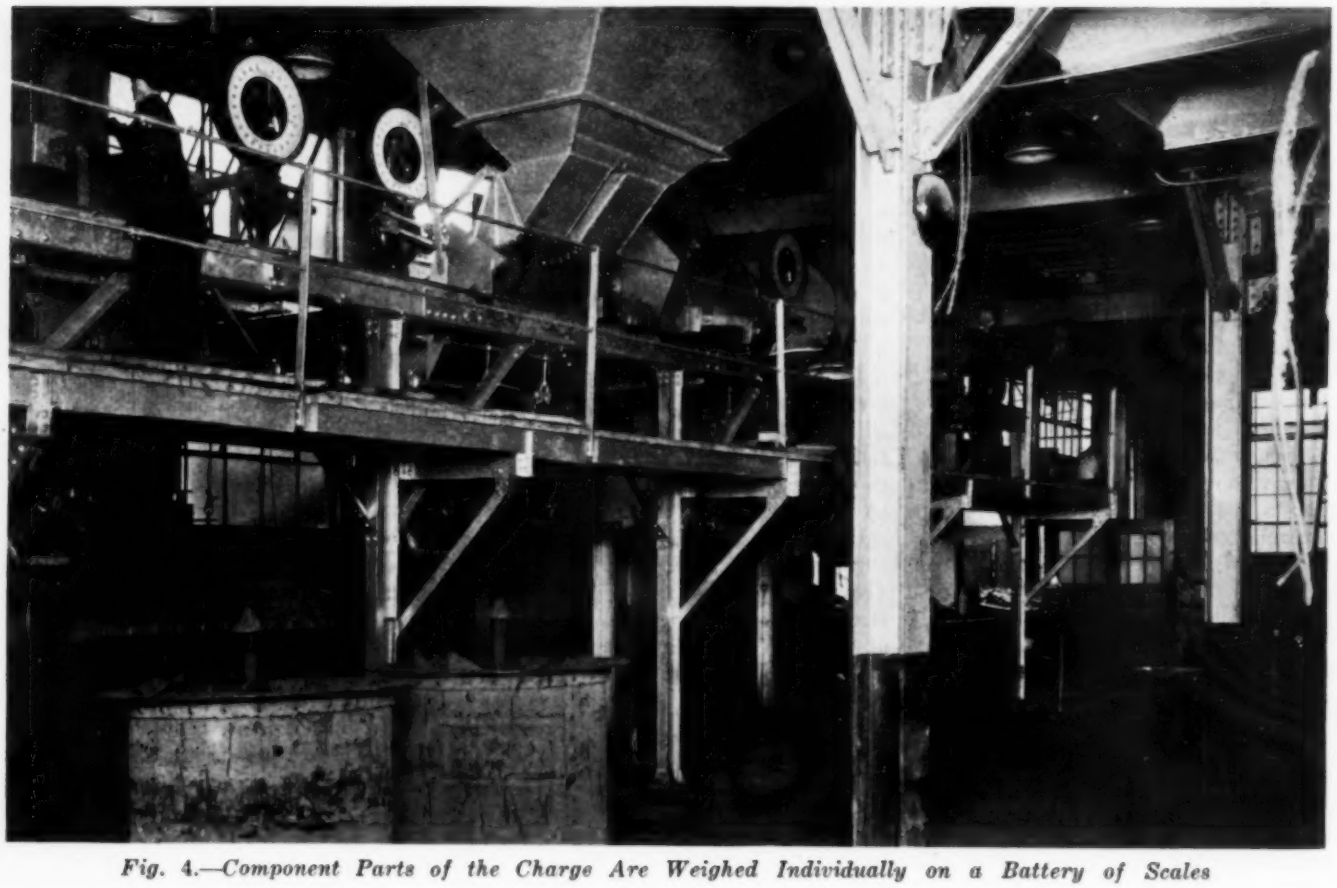


Fig. 4.—Component Parts of the Charge Are Weighed Individually on a Battery of Scales

into the tube located in the center.

Under ordinary conditions, shipments of coke are reasonably prompt and sure, but this coke storage tank containing approximately a week's supply, constitutes a flexible link in the chain of operation that will insure steadiness of melting even during temporarily interrupted coke shipping periods. The illustration shown in Fig. 2 was made before the coke handling unit was completed. The structure on the right is one of the runways for the stockyard crane.

Each tank section is equipped with a gate at the bottom controlled by a pendant rod terminating in a rectangular loop for a handle. Upon the release of any gate the contents of the pocket fall through a steel funnel which directs the material into a steel charging bucket resting on the table of a scale set flush with the floor. In this particular instance when the scale registers 400 pounds the operator releases the long rod and this action in turn closes the gate above.

Limestone for the charges is used in the proportion of 30 to 35 pounds of limestone per 100 pounds of coke, depending on the condition and composition of the coke. Thus the operator watching the dial of the scale releases the handle controlling the gate in the limestone pocket, when the pointer marks 120 to 140 pounds.

Steel buckets employed for weighing and conveying the various materials to the cupola are made up of a bottom which rises to a cone point in the center, and a riveted ring reinforced with a 5-inch flat strap around the outside lower edge and a 5-inch flange around the top. A 2-inch steel bolt with a mushroom head 3 inches diameter at the base of the head is attached to the bottom of the bucket at the center, or highest point.

Fig. 6.—The Charging Bucket Is Suspended by a Center Bolt From the Cross Member of a Specially Designed Lift Truck

A truck specially designed and constructed by the Automatic Transportation Co., Buffalo, and shown in Fig. 6, is employed for transporting the loaded bucket from the scale platform to a point on the floor under one of the four elliptical openings in the charging floor. A heavily reinforced superstructure on the truck is provided with a narrow slot in the top horizontal member. The slot is flared at the outer edge so that the truck driver readily may engage the upright

Fig. 5—Cylinder Block Cores Are Assembled in a Special Jig, Then Lifted as a Unit and Placed in the Mold

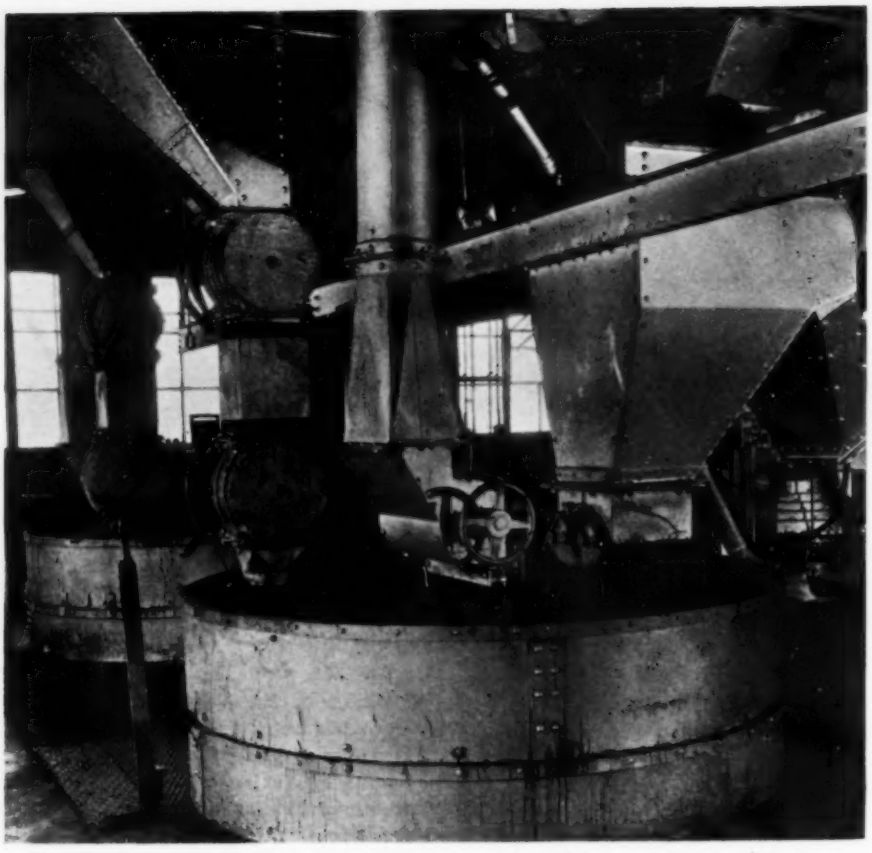


Fig. 7—New and Old Sand and Coal Dust Are Measured Accurately in a Pair of Facing Sand Mixers of the Muller Type

steel bolt in the center of the charging bucket. Thus when the truck lifts the bucket from the floor the entire weight is suspended from the mushroom head of the center bolt.

Under the opening in the charging floor, the bucket is attached to the cable of a hoist which lifts it to a point about 3 feet above the charging floor level and then moves forward horizontally and places it in the cupola.

Cost of erecting the cupola building was reduced to a considerable extent by installing rigid beams to serve as runways for four individual charging cranes. Instead of erecting a building to support the runways, the runways in this instance serve to reinforce the building. Each of the four 3-ton charging cranes made by the Whiting Corp., Harvey, Ill., is equipped with two motors, one for the hoist and one for the rack and its movements are controlled by the operator on the floor.

Another interesting feature of this new hoist is that it moves as a unit with no change in the position of the load in relation to where the stress is applied to the carriage. The member to which the load is attached is suspended from the carriage at four points close to the four wheels and projects in front a sufficient distance to place the bucket in the cupola before the end of the carriage touches the outside of the cupola shell. A familiar illustration of the manner in which the load is distributed is found in the schoolboy trick of maintaining a pencil at any desired angle by the simple expedient of sticking the point of a jack knife blade in the pencil close to the pointed end, and then adjusting the angle of the handle and blade in accordance with the demands produced by the law of gravity.

The charging bucket enters the cupola and is lowered a short distance until the horizontal flange surrounding the top on the outside comes to rest on a cast iron yoke anchored to the furnace shell. This yoke is considerably smaller than the diameter of the brick lining and is designed to fit the outside of the bucket fairly closely. With the flange resting on this yoke, the shell of the bucket remains stationary and as a result the loose bottom continues to descend, thus discharging the load. The cone distributes the material uniformly.

Borings from the machine shop are brought in carloads to a point close to the west end of the stockyard. Here they are transferred by magnet to a hopper which feeds them continuously to a briqueting machine made by the Southwark Foundry & Machine Co., Philadelphia.

This machine which utilizes electric and hydraulic power, compresses the material under 300 tons per square inch pressure into disks 4 inches diameter and 4 inches in thickness, and an average weight of 7½ pounds. It is automatic in operation and is capable of discharging the briquets at the rate of 18 per minute. Under a pressure of 300 tons per square inch no bond is needed with the borings.

In round numbers the borings represent a scrap value of $10 per ton on the plant as compared with the best grade of cast iron scrap at $20 per ton. On an estimated consumption of 30 tons of briquets per day the saving effected amounts to $300, sufficient to absorb the cost of the machine in about 10 months of ordinary operation.

The stockyard extends for a dis-

Fig. 8—Cylinder Block Molds Are Cored, Closed and Afterward Poured While Moving

tance of 270 feet east and west across the south end of the foundry. It is spanned by a 10-ton crane, 80-foot span made by the Whiting Corp., Harvey, Ill. This crane is of the three motor type, is equipped with a magnet and shows a clearance of 30 feet 6 inches under the bridge. Also it handles all the pig iron and scrap, first from the incoming railroad cars to the various stockpiles and later from the stockpiles to long hoppers above five conveyor lines that carry them into the weighing room that serves the charging floor. This method of transferring this kind of material is an innovation in foundry practice and is attracting considerable attention among foundry engineers and operators. Whether the equipment will stand up under the severe service only can be determined after the lapse of a reasonable period of time.

Fig. 10—Small and Large Flasks Are Liberally Vented to Allow the Escape of Steam and Gas. Copes and Drags Are Solid One-Piece Castings

Weighed Accurately

Each conveyor is operated electrically under push button control. At the inner end the material falls into a pocket where the weight is registered automatically on one of the scales made by the Toledo Scale Co., Toledo. When the proper weight is shown, the operator stops the conveyor and at the same time releases the charge in the pocket so that it falls into a waiting steel charging bucket.

A constant succession of these buckets is placed on a roller conveyor beneath the row of pockets. A certain amount of each kind of material is taken on at each spout to make up the total of 4000 pounds. For example in making up the cylinder charges each bucket receives 1670 pounds malleable pig iron, 870 pounds basic pig iron, 690 pounds steel scrap and the remainder—770 pounds domestic and foreign scrap. The bucket is shoved along from chute to chute by an air cylinder and hinged pushers until it reaches the end of the line where it is picked up by the truck previously described and placed on the floor under one of the elliptical openings in the charging floor. As with the coke, it is taken aloft, discharged into the cupola and returned to be again placed in line on the conveyor under the pig and scrap chutes.

The charge make up receiving hoppers, feeding conveyors, weigh boxes and pusher unit for charging buckets were made by the Link-Belt Co., Chicago.

Through a well equipped laboratory a close check is kept on the character of the material entering the cupolas, also upon the composition and physical characteristics of the resulting castings which are subjected to severe tests.

Molten metal is taken from the cupolas in a special crane, cab and ladle combination made by the Sprague division of the Shepard-Niles Crane & Hoist Corp., Montour Falls, N. Y. Several of these devices are suspended from a monorail that serves the various pouring stations. The operator travels with the ladle and transfers metal at the pouring stations either to small crane ladles, or to hand ladles. The small crane ladles are suspended from a series of monorails and are operated under push button control, as developed by the tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O.

The foundry floor is laid off into seven units, each complete in itself

Fig. 9—Small Flasks Are Shaken Out By the Simple Expedient of Dropping Them on a Pair of Short Rails

with molding machines, power driven conveyor, shakeout equipment, sand handling equipment and small hoists. On a tentative arrangement the seven units are devoted to the production of: Cylinder blocks, cylinder heads, manifolds, fly wheels, transmission cases, clutch plates and pistons, but under stress of circumstances two conveyors may be devoted to one casting, while on other occasions, two or more varieties of castings may be made on one conveyor.

Cope and drag molds for the cylinder blocks are made on the most easterly conveyor on four jolt-squeeze-strip machines supplied by the Osborn Mfg. Co., Cleveland. One of these machines with the runout mechanism, sand supply hoppers, conveyor and hoist is shown in Fig. 8 and is typical of the others. Under normal operating conditions the output of each pair of machines is given as 60 per hour or between 400 and 500 for the regular day's work.

That company also supplied six jolt-squeeze-strip machines for making cylinder head and manifold molds; four similar machines for making fly wheel housing and transmission case molds; and four jolt rollover squeeze pattern draw machines for making fly wheel and transmission case housings molds.

Several units are equipped with molding machines made by the Wm. H. Nicholls Co., Inc., Richmond Hill, Long Island, N. Y., including 15 jolt-squeeze-draw machines and four somewhat similar machines with a flask runoff feature in addition to the others. One valve serves to jolt and squeeze the mold, strip the pattern and discharge the completed mold. The base of the machine with cylinder and all projections supporting uprights, valve guides and bushings, is cast in one piece. The cross arm is a steel casting swinging on a double race ball bearings located at the top and bottom of the support for the cross arm.

Facing sand is prepared in two 8-foot diameter sand-mixers made by the National Engineering Co., Chicago. In addition to the pans with rollers nicely adjusted to impart a mulling action to the sand, the installation includes mechanical equipment for measuring new sand, old sand, coal dust and water, further equipment for conveying and storing the sand before and after it is treated and finally a small individual pulverizer where coal dust is prepared in quantities sufficient to meet the requirements of this material for the plant.

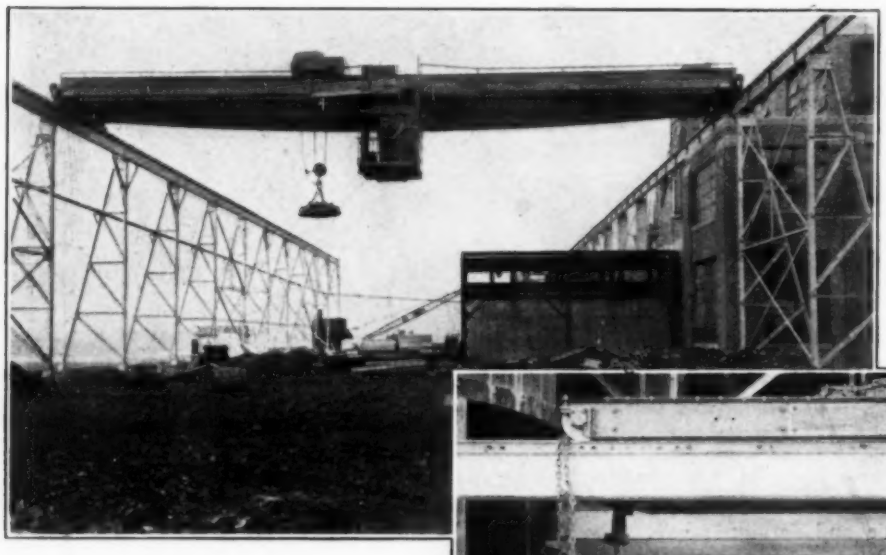


Fig. 11—The Stockyard is Spanned by a 10-Ton, 80-Foot Span Equipped With a Magnet. This Picture Was Taken Before the Foundry Went Into Operation

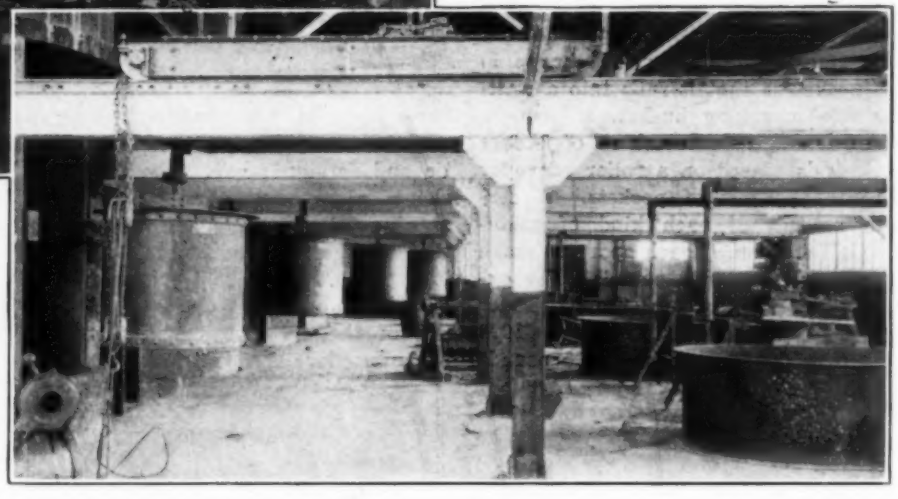


Fig. 12—General View of Charging Floor and Equipment During Installation Period

This is the second of a series of four articles describing, in considerable detail, plant, equipment and methods employed at the new foundry recently erected and placed in operation at Pontiac, Mich., by the Oakland Motor Car division of the General Motors Corp. Succeeding articles in the series will be presented in early issues of THE FOUNDRY.—The Editors.

Institute Adds Nine New Members

Gray Iron institute, Terminal Tower building, Cleveland, recently added the following foundries to its membership list: Niagara Foundry Co., Niagara Falls, N. Y.; Lawler Iron Works, Buffalo; Lake Erie Foundry Co., Buffalo; United States Wind Engine & Pump Co., Batavia, Ill.; New England Butt Co., Providence, R. I.; Rosedale Foundry & Machine Co., Pittsburgh; Pitz Foundry Inc., Brooklyn, N. Y.; Pero Foundry Co., Worcester, Mass., and A. P. Grimm Foundry Co. Inc., Bound Brook, N. J.

Transferred to Toledo

E. A. Weaver, district manager of the Boston office of the Surface Combustion Co., Toledo, O., has been transferred to the home office. Mr. Weaver will have charge of sales promotional work. John R. Waltman, connected with the sales department at Toledo, will be transferred to the Boston office as district manager. The New England district office will be maintained in the building of the Boston Consolidated Gas Co., Boston.

Issues New Catalog

Hines Mfg. Co., 10106-10108 Detroit avenue, Cleveland, recently has issued an attractive, 16-page catalog describing the line of foundry flasks that it manufactures. The catalog describes and illustrates flasks for use in aluminum, brass, iron, malleable and steel foundries and of many different shapes. Details of construction also are shown.

American Foundry Equipment Co., Mishawaka, Ind., recently has opened a sales office at 228 North La Salle street, Chicago.

Controls Materials

Through Accurate Cost Records

By R. E. Shallberg

PRESENT day tendency toward better management methods obviously necessitates improved record keeping, and this is especially true in controlling expenditures and operating procedure in the average gray iron foundry. Foundry record keeping generally is difficult to maintain because of the complications attending the weighing and proper preparation of cupola charges and the resulting yields in perfect castings, scrap and oxidation losses.

The two fundamental factors which establish the record in the operation of a foundry are the weight of raw materials charged in the cupola and the weight of perfect castings produced. Errors in these two factors cause considerable variation in cost and stores records, and a proper record and plan are necessary to obtain accurate results.

Fig. 2 illustrates a typical cupola charge sheet listing the various charges of pig iron, scrap, coke, etc., placed in the cupola each day. Although this charge sheet is considered an official tabulation of the charges placed in the cupola it is in reality not a record of actual performance. The charge sheet may specify twenty-six 1600-pound charges with an extra 1100 pounds for the twenty-seventh charge but each of these charges may be from 50 to 100 pounds overweight.

Foundry Inventory Check Slip

Date of check Oct. 15, 1928

Kind of Material Hard Pig

Heat No. 67 Charge No. 10

Cupola No. 2

Cars in yard No. L&N 9056

No. 870-7322 No. L&N 300 No. Sou 8526

Signed L. H. G.
Foundry Supt.

FIG. 1—FOUNDRY INVENTORY CHECK SLIP

The official tabulation will show the gross charge as 42,700 pounds whereas the actual amount consumed in the cupola may be closer to 45,000 pounds. Many opportunities exist for these discrepancies which can be traced to use of the beam type scale. Weighing the iron loaded in the barrows, boxes or pans requires 100 or more calculations per heat by the weighman.

The beam type scale is difficult to balance to the exact weight and the average weighman usually will make certain that the weight is slightly heavy rather than exact or light. As a consequence he builds up a surplus which was not intended in the planned or predetermined list of charges. To manipulate the beam type scale naturally requires some degree of skill and intelligence, hard to find in the

CUPOLA No. 1 HEAT No. 217

MOULDERS EMPLOYED
PRODUCTION 28
EQUIPMENT 4
TOTAL 32

B. F. AVERY & SONS, Louisville, Ky.

CUPOLA CHARGE SHEET

DATE April 4 1929

CHARGE No.	WEIGHT OF METAL IN CHARGE	WEIGHT OF COKE IN CHARGE	PIG IRON: CHARCOAL Hard #2 So 7345	PIG IRON: Hard P.R.R. 870503	PIG IRON: Soft L&N 26745	PIG IRON: Soft L&N 26759	PIG IRON: Foreign Scrap Hard	Malleable	CUPOLA BOTTOM AND MISC. RETURN	SHOP PIGS	CAR WHEEL SCRAP	STEEL SCRAP	RETURN CAST IRON SCRAP	FOREIGN CAST IRON SCRAP	LIME-STONE	
BED	1600	2400	400	400			400			200		200				
2	1600	200		800				200		200		100	300		60	
3	1600	200		800				200		200		100	300		60	
4	1600	200		800				200		100		100	400		60	
5	1600	180		800			70	200				100	430		60	
6	1600	180		800			500	200				100			60	
7	1600	180		800					120			100		580	60	
8	1600	180			800				800						60	
25	1600	160				800								800	60	
26	1600	160				800								800	60	
27	1100	130				500								600		
28																
29																
30																
31																
32																
33																
TOTAL	42700	6810	400	5200	3200	12500	970	1000	920	1500		800	4700	11510	1440	

BLAST ON 1:58 P. M.

BOTTOM DROPPED 4:18 P. M.

Return Coke	740	lbs.
Core Room Coke	840	lbs.
Ladle Oven Coke	155	lbs.
Coke Sweepings	645	lbs.

Remarks

Signed L. H. Gohman

FIG. 2—CUPOLA CHARGE SHEET SHOWING THE RELATIVE AMOUNT OF EACH AND THE TOTALS OF ALL THE MATERIALS CHARGED INTO THE CUPOLA

labor usually employed on this class of work. The dial scale is now used to some extent. This type of scale is direct reading. No skill is required in its operation and accurate weighings with unskilled labor has resulted.

Usually coke and limestone charges are not weighed but are estimated by the number of forks or shovels placed in the cupola. Apparently this method presents plenty of opportunity for huge discrepancies between the estimated weight and the actual weight charged. Those who desire to check the coke ratio cannot depend upon the charge sheets to disclose this information with any degree of accuracy.

Obviously, some method is needed to determine the actual amount of raw materials consumed in the cupola if the charge sheets are not dependable. The discrepancies if allowed to continue for a considerable period ultimately will amount to huge proportions and will mislead the executive as to the actual cost of operation. Where foundries maintain a perpetual stores record and only determine the actual inventory once each year, the real significance of the discrepancies in raw materials is apparent.

A record of oxidation and coke ratio easily can be maintained to discover errors in the consumption record. An example of this record is shown in Fig. 4. In the first column the record is shown for September 1928 as reported from the summarization of the cupola charge sheets for that month. Note the low percentage of oxidation and the usual coke ratio of 9.23 pounds iron.

The report indicates that an insufficient consumption of metal has been recorded as the oxidation should be approximately 5 per cent. Likewise the coke consumption is low as a 7 to 1 ratio represents average practice. In the second column, the corrected report for September 1928 shows results in accord with the average run of gray iron foundries.

Accuracy Is Obtained

Accuracy may be maintained in the consumption record by periodic inventories of iron, coke and other materials used in the cupola. The raw materials must be stored or stacked in the yard by carload lots, with the car number recorded on each stack. Scrap should be segregated into carload lots by rough partitions. Where limestone and other materials are stored in sheds, the various car loads should be placed in separate bins and properly marked.

For example, we desire to check our records on the consumption of hard pig iron. On Oct. 15 pig iron from a new car of this material is charged in the cupola. A record can be made of the heat and charge number, as shown on the form in Fig. 1.

Assuming the foundry records are monthly, the summary of hard pig reported on charge sheets from Oct. 1, to 14, plus the proper number of charges on Oct. 15, will disclose the hard pig consumption according to the charge sheet. The next step is to deduct this consumption from stores record on hard pig as of Sept. 30, and the balance should be the weight of the cars of that material still remaining in the yard. The error disclosed may be corrected by adjusting the consumption of hard pig iron for the month of October.

Accuracy of cost, production and general foundry records depends to a large extent on the correct weighing of finished castings. Despite this fact the weighing of finished castings generally is considered a minor operation.

On account of variation in the weights of castings with the same pattern number the average weight should be recorded. For this purpose the weighman in recording the pattern number, quality, weight, etc., on the *material way bill* illustrated in Fig. 5, should make a carbon copy *casting issue*, shown in Fig. 3. The *material way bill* is sent with the truck load of castings to its destination, but the *casting issue* ticket is retained by the foundry superintendent, or by the department recording the weights of finished castings. A summarization of the *casting issue* tickets for the average weights of the various castings may be conducted at the close of each month, or at various periods during the year. The average weights obtained may be used for standard weights or for checking efficiency in molding.

Considerable attention should be given to the inspection of scales used in all foundry departments, and it will be found a profitable investment to employ a scale expert at periodic intervals for this week. Although weigh scales are usually of rugged construction thus insuring long service, various deteriorating elements occasionally work into the mechanism and inaccurate weights are recorded.

	Sept.1928 As Reported	Sept.1928 As Corrected
Gross Metal Charge	1,384,000	1,500,000
Good Castings	1,020,000	1,020,000
Bad Castings Gates and Excess Melt	350,000	350,000
Oxidation or Melting Loss	14,000	75,000
% age of Gross Charge	1.00%	5.00%
Coke Charge	150,000	214,000
Ratio Gross Charge to Coke Charge	9.23	7.01
% age of Good Castings to Gross Charge	73.7%	68.0%

Fig. 4 (Top)—Record of Oxidation and Coke Ratio

Fig. 3 (Below)—Casting Issue Ticket for Cost Records.

Fig. 5 (Below)—Material Way Bill to Accompany the Castings When Delivered to the Customer

Send Ticket to Cost Record Division			CASTING ISSUE				Deliver To Dept. No. 18			MATERIAL WAY BILL	
Order and Item		Quantity	DESCRIPTION				Order and Item		Quantity	DESCRIPTION	
PATTERN NO. A-502		310					PATTERN NO. A-502		310		
				WEIGHT	Wt.Per Unit	Standard Wt.	DELIVERY BY		RECEIVED BY		WEIGHT
3	J.C.	18	B.C.Q.	630	2.03	1.98	Dept. 3	Per J.C.	Dept. 18	Per B.C.Q.	630

Study Pattern Design

Manual Dexterity in the Actual Construction of Patterns Is not Considered a Necessary Feature in the Education of Engineering Students

By B. Rupert Hall

INTEREST now shown by manufacturers in various lines in the collegiate training of engineering students is a real incentive for those engaged in presenting subjects dealing with manufacturing processes. The manufacturer wants to know what the student really is getting in a theoretical and practical way to assist him when he enters upon the activities of industrial life.

Apparent desire for co-operation between manufacturers and educators should result in working out a course of instruction applicable to the various crafts executing the numerous processes involved that will prove valuable commercially and also will exert a broadening effect on general education.

Use Visualizing Ability

Considering the value of the training in actual manual work necessary to produce a pattern and the amount of time consumed, it appears to be expedient to sacrifice this feature and utilize the visualizing ability of the student by substituting sketching and drawing to express ideas. Ability to do free hand sketching and instrument drawing is a valuable engineering asset.

Pattern design is the basis of the work at the University of Illinois and is demonstrated by various types of patterns, coreboxes and auxiliary equipment. A text *Pattern Design and Management* has been prepared solely for the purpose of giving the student only that which is important in the engineering profession in this phase of his work in the university.

Drawings submitted for a cast part often show that the designer has only a meager conception of the processes involved in producing the piece. Faulty design, a daily commercial problem, causes considerable momentary loss. The designer informed on the subject of manufacturing processes can prevent these losses.

To build a passable pattern requires considerable time. Manual work has its advantages, but I do not consider it of sufficient worth to occupy the time of a student while he familiarizes himself with all the details.

Pattern design is presented with the thought of familiarizing the student with the various ways and means of meeting the requirement with the least possible effort. By a careful study of these processes he is enabled to design a cast part in a way to facilitate the work of all concerned.

Casting design, pattern design and pattern construction are studied in a thoroughly practical manner.

Successive Steps

For pattern construction the student is given a problem that includes many different methods in joinery. He sketches the form of the piece or pieces required to construct the pattern.

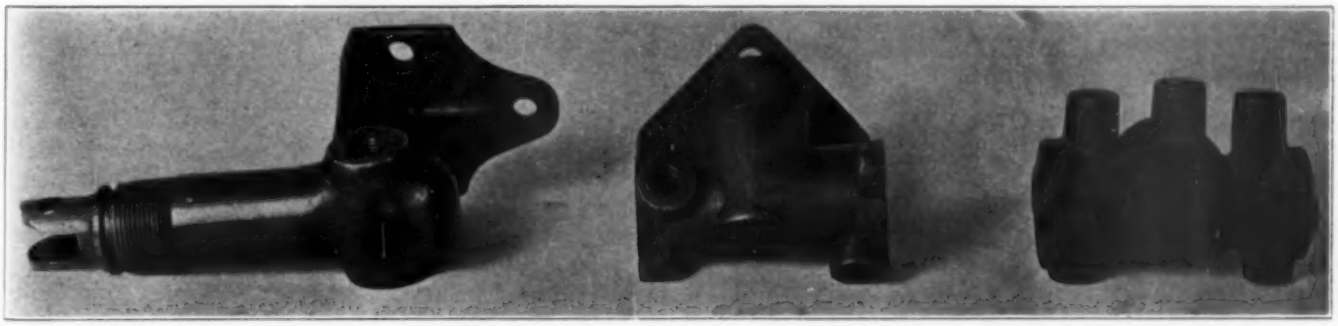
The next step takes up study of the master pattern necessary to produce the metal working pattern or patterns; also the triple shrink pattern and its purpose. Metal pattern equipment, including pattern plate, patterns, coreboxes, core driers, core wire, binding devices, core setting devices, etc., is studied extensively. Special problems are presented to encourage design of mechanical equipment and improved molding and core making methods.

Many drawings of cast parts may be simplified in design and these present interesting and practical problems. A survey of blue prints or drawings of parts actually in use, will verify this statement. These furnish splendid problems. The student feels that his ingenuity is being put to a real, practical test. Analyzing work of this character displays his initiative, develops his ingenuity and proves his aptitude for mechanical work.

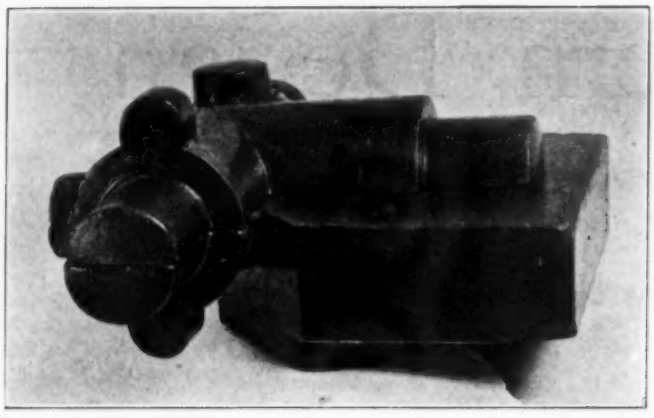
Careful Study Required

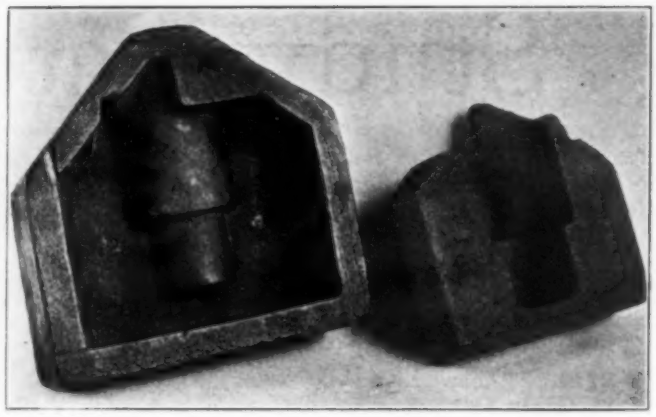
Each student is given a sheet of instructions explaining the necessary detail work. Problems of an elementary nature, but requiring careful study have been selected to introduce the student into the work. The ability of the student quickly is shown in devising ways and means of accomplishing desired results and a problem in keeping with his ability is given him for solution. In this method of instruction the alert student is not compelled to wait for those who are less fortunate.

The engineer's job is to improve ways and means of speeding production. Patterns must be designed to facilitate the molding operation as much as possible. Design of castings calls for intimate knowledge on the part of the designer, sane workable methods of pattern design, molding work and machine shop methods.



FIGS. 1, 2 AND 3—SUCCESSIVE STEPS IN SIMPLIFYING THE DESIGN OF A PATTERN FOR A SMALL PUMP CASTING





FIGS. 4 AND 5—PATTERN, COREBOX AND CORE REQUIRED IN MOLDING THE CASTING SHOWN IN FIG. 2

Simplification of design is illustrated by actual examples in presenting the subject of patterns.

For example, Fig. 1 shows a pump casting as it first was used on a gas engine. This design necessitated placing the pump cylinder quite distant from the machine. It could have been brought closer to the engine, thus utilizing space to better advantage and giving greater rigidity to the assemblage. In certain instances this design may be necessary for the piece to function without interfering with other parts of the mechanism. For rigidity and compactness it is advisable to locate the piece close to the point of support wherever possible. This casting was molded easily. It required merely a two-part pattern with a straight parting. An improvement of this design is shown in Fig. 2. The pump body is located closer to the general machine, giving greater rigidity to the pump generally and an appearance of compactness. These are important advantages over the first design as shown in Fig. 1.

The designer, no doubt, had in mind rigidity and compactness, but no thought apparently was given to the problem involved in production of the casting in quantities when he designed the pattern for the casting shown in Fig. 4.

The pattern consists of two parts, the cope *A* and the drag *B* with a core print C to core out the space between the pump barrel *D* and the web *E* by which the pump is secured to the crankcase. In this design it is evident that a dry sand core *G*, Fig. 5 must be used to form the opening between the web *E* and the barrel *D* of the pump as shown in Fig. 2.

In addition to the pattern, this design involves the extra work of satisfactorily arranging the core print *G* and making the corebox *F*, Fig. 5. Time spent on arranging pattern equipment is of minor importance when reckoned against the time required to produce the casting. Every detail should be planned carefully on the basis of increasing the production of the castings at the lowest cost.

The design was simplified by doing away with the web base as shown in Fig. 2 and substituting three posts or standards, see Fig. 3, by which the pump is attached to the crankcase. The mounted metal patterns are shown in Fig. 6.

Book Review

Foundry Practice—by R. H. Palmer, cloth, 450 pages, 5¼ x 8¼ inches, published by John Wiley & Sons Inc., New York, and supplied by THE FOUNDRY, Cleveland, for $3.50 plus 15 cents postage. The book may be obtained in London from the Penton Publishing Co., Ltd., 416-17 Caxton House, Westminster, for 17s 6d., postage extra.

This is the fourth edition of the work by Mr. Palmer. The text has been partly rewritten and is considerably larger than in the previous issues. The chapters on cleaning castings, molding machines, molding sands, iron and its composition and cupola operation have been enlarged and brought up-to-date. Appendices have been added on methods of molding rolls and on molding a planer table and the appendix on useful information has been increased. The book is well illustrated and contains much information on foundry molding practice. The author formerly was instructor in foundry practice in Worcester Polytechnic institute, Worcester, Mass.

Gives Equipment Orders

The index for gross orders for foundry equipment for June was 177.3 as compared with 177.7 for May, according to a recent report of the Foundry Equipment Manufacturers' association. The index of shipments for June was 172.7 as compared with 217.0 for May. Unfilled orders for June were 300.8 against 323.8 for May. The base is the average monthly shipments for the years 1922-23-24. Comparisons of monthly orders as presented by the Foundry Equipment Manufacturers' association follow:

Month	1926	1927	1928	1929
Jan.	168.2	180.4	132.7	180.5
Feb.	154.9	198.0	123.6	197.0
March	157.3	131.1	138.6	209.4
April	113.2	130.0	107.7	172.6
May	128.5	134.8	335.6	177.7
June	133.5	138.4	149.1	177.8
July	127.3	89.9	94.8	.....
Aug.	141.2	106.4	278.0	.....
Sept.	114.0	80.4	170.0	.....
Oct.	140.5	98.0	185.0	.....
Nov.	133.4	95.8	197.8	.....
Dec.	181.0	106.8	166.5	.....

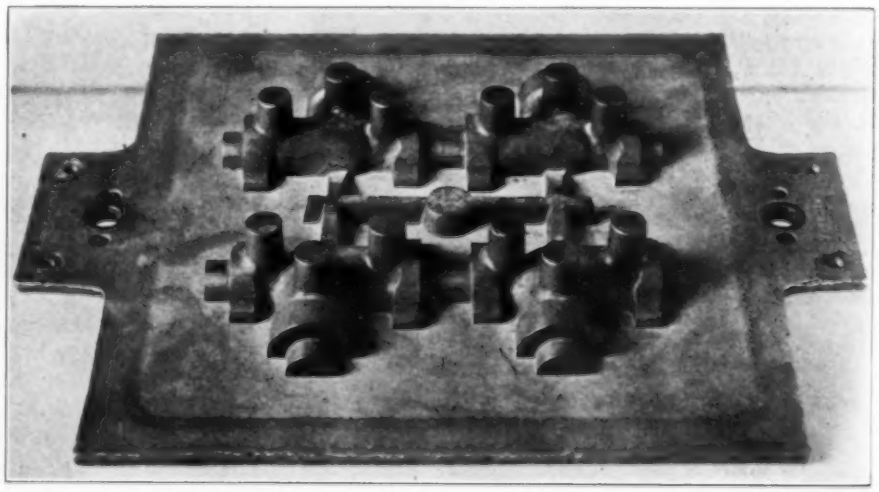


FIG. 6—THE SIMPLIFIED PATTERN FOR THE CASTING AS SHOWN IN FIG. 3, GREATLY FACILITATED THE WORK IN THE FOUNDRY

Questions & Answers on FOUNDRY PRACTICE

GRAY IRON

Wants High Tensile

QUESTION

A few weeks ago we heard that a certain firm was making a cast iron in its foundry which has a tensile strength of 60,000 pounds per square inch. Have you any information on this iron?

ANSWER

While we do not have any information on how the foundry referred to produces the particular iron in question, many other foundries in the country are making cast iron that will reach the tensile strength mentioned. M. E. Greenhow in the Dec. 1, 1927 issue of THE FOUNDRY describes the manufacture of a cast iron containing about 2 per cent nickel with a tensile strength of 61,320 pounds per square inch, and a brinell hardness of 163. This iron was melted in a 36-inch cupola and the charge consisted of 1000 pounds of coil springs with 15 pounds of 50 per cent ferrosilicon. Ladle additions per 100 pounds of metal consisted of 12 ounces of 70 per cent ferromanganese; 8 ounces of 50 per cent ferrosilicon, and 24 ounces of nickel shot.

To insure sufficient heat to produce the high temperature, Greenhow recommends a coke to metal ratio not greater than 1 to 6½ or 7. Slightly higher blast pressure also is advocated. An initial coke bed from 40 to 50 inches above the tuyeres is ignited and burned to incandescence throughout, then about 6 inches more coke is added and the metal and coke charged successfully until 8 or ten tons is charged according to the size of the cupola. The stock is allowed to soak for at least an hour, preferably two. All ladle additions are preheated.

While Greenhow introduces the nickel as a ladle addition, it may be added directly in the cupola as it is not affected by oxidizing conditions. If you desire to add small amounts of chromium also, it may be accomplished by using a chromium-nickel bearing pig iron; an alloy containing nickel and chromium, or by adding ground ferrochromium in the ladle.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Steel Casting
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Editor, The Foundry, Penton Building, Cleveland.

Q & A

Cores Straight Hole

QUESTION

At present we are drilling a 1 7/16-inch hole through a light casting which varies from 2¼ to 3 inches in diameter in a length of 20 inches. Sometimes the drill runs off and we are wondering if it is practical to core a perfectly straight 1-inch hole through the casting. This would serve the double purpose of lightening the casting and acting as a guide for the drill to keep it true. The casting carries a flange 7½ inches diameter at one end and is designed to be molded and poured in an upright position.

ANSWER

The idea of coring the hole is quite feasible provided certain precautions are observed. The core must be exceedingly porous so that it will not cause the least flutter in the ascending iron. Clear sharp sand is the best for this purpose, bonded preferably with oil, but where the coremaker is accustomed to other forms of binder satisfactory cores may be produced. For one or two castings the core could be rammed in an ordinary two part wood corebox and rolled on to a flat plate as a unit. Two wires are rammed in with the sand. One is allowed to remain to stiffen the core. The second is pulled out to form a vent hole through the core. If a considerable number of castings are required the proper way to produce straight, true cores is to make them on an extrusion type core machine which will make them to any desired length. These machines also are supplied with accessory trays which receive the green cores from the tube and support them until they are dried. With a good grade of silica or other highly refractory sand, no blacking will be required on the cores. However, if a trial shows that the sand does not clean out perfectly, a coating of blacking on the core will insure a clean surface all through the opening. It seems to us that you are allowing more stock to clean up than is necessary. We suggest you try a 1¼-inch diameter core. You still have 3/32-inch metal on which to clean up.

Q & A

Effect of Molybdenum

QUESTION

We would like to secure some molybdenum for producing cylinder iron. Can you give us a source of supply and some information on its effect?

ANSWER

Ferromolybdenum or calcium molybdate is used by steel makers to give certain desired properties such as resistance to impact, increased strength and toughness. It generally is used with other alloys such as chromium and nickel. Roll makers using the air furnace or open hearth, also use molybdenum as an alloying agent to improve the product. It is found that molybdenum gives a much

better control of the chill than is possible otherwise. It also gives a hard surface desired for certain rolling operations, and like in steel is used in combination with other alloys.

As far as we are aware little has been published on the use of molybdenum in gray iron. Smalley carried out some tests on the addition of molybdenum to cast iron and found that in general the brinell hardness, tensile strength, compressive strength, transverse strength and deflection were increased. Some of his results follow. In an iron containing 1.92 per cent silicon with 0.52 per cent molybdenum, the brinell hardness was increased 20; tensile strength was increased 2000 pounds; compressive strength, increased 16,000 pounds; transverse strength, increased 1100 pounds, and deflection, increased 0.03-inch. Another iron containing 1.68 per cent silicon and 1.55 per cent molybdenum, brinell hardness was increased 46; tensile strength, 10,000 pounds; compressive strength increased 28,000 pounds; traverse strength, increased 300 pounds, and deflection remained the same.

Ferromolybdenum containing 55 to 65 per cent molybdenum may be obtained from companies represented in the advertising pages of THE FOUNDRY. It has a high melting point and probably will have to be added in the cupola. According to information at hand, it is not subject to oxidation and the recovery should be as good as that of nickel additions.

MALLEABLE

Corrosion Resistance

QUESTION

A question has arisen in connection with the use of our malleable conduit fittings as to whether or not they would withstand the action of steam and acid fumes as well as gray iron castings and stamped steel fittings. Tests made by us have led us to believe that malleable castings would stand up under any exposed weather condition or acid fume condition as well as gray iron castings.

ANSWER

Data on the corrosion of cast iron and malleable cast iron are not informative as to the effect of steam and acid. The only data that we find was given in the *Transactions* of the American Foundrymen's association, vol. 32, Part I. These data refer only to the accelerated salt spray test. A summary shows that the average loss for gray iron is approximately 10.5 ounces per square foot per year. For malleable the loss is about 12 ounces on the same basis. One authority gives the following data: Sample submerged in salt water; cast iron, average for two years—0.019 grams per square centimeter; malleable cast iron, for same period—0.015 grams per square centimeter. Sample exposed to salt spray; cast iron, average for two years—0.104 grams per square centimeter; malleable cast iron, average for same period—0.096 grams per square centimeter.

Q & A

Making Annealing Pots

QUESTION

Our firm which is located in Belgium has been making white cast iron pots for a number of years. Although the price is low, steel annealing pots which sell for much more have been cutting into our business. Can you tell us if in America there is a mixture that can be made in the cupola which will compete with the steel pots?

ANSWER

An average composition used in making annealing boxes for the heat treatment of malleable cast iron contains 0.65 per cent silicon; below 0.20 per cent manganese; below 0.08 per cent sulphur; below 0.20 per cent phosphorus, and total carbon, below 3.50 per cent. One firm making pots uses a charge containing 1250 pounds of gates and runners; 300 pounds of steel scrap; 200 pounds of malleable scrap, and 250 pounds of pig iron. The pig iron used is high phosphorus and has a silicon content about 2.75 per cent. Annealing boxes made of plain carbon steel are not used to any great extent in this country because although the life may be longer, the cost per heat is greater than with white iron boxes. Boxes made of nickel-chromium alloy are being used, but the metal is melted in the electric furnace. You might try making additions of ferrochromium and nickel to your metal at the spout. The ferrochromium must be not greater than ¼-inch in size and is placed in a paper bag. The bag is dropped at the junction of the stream and the metal in the ladle just after beginning to fill the ladle. Add about 1 pound of ferrochromium and 2 pounds of nickel per 100 of iron.

STEEL

Cores Resist Hot Steel

QUESTION

What mixture of core sand and what wash can be used most satisfactorily for small cores in die blocks and other heavy steel castings?

ANSWER

Several factors must be taken into consideration in addition to the core sand mixture and the wash to prevent a heavy body of steel from burning into a core. Size and shape of the core and its position in the mold, determine in some instances the precautions to be observed. There is no magic or secret mixture of core sand or wash that will save a core if other contributory factors are neglected. In many instances, particularly for circular holes, it has been found more convenient to drill the holes in the casting instead of attempting to core them. Occasionally conditions favor the use of short pipe lengths filled with dry silica flour and sawdust. Under favorable conditions the filling may be omitted, but in the majority of cases it is essential to prevent the pipe from collapsing under the liquid pressure while in a soft and plastic condition.

Sometimes the regular core mixture is substituted for the silica flour and sawdust. If this is done a large vent hole must be provided in the center of the core. Otherwise the sand will fuse into a solid mass and the advantage of the pipe as a protective sheath will be lost. Every core subjected to high temperature or pressure, or both, whether bare or inside a protective metal coating, should be provided with as large a vent channel as possible. A solid core made from a mixture of silica sand and silica flour bonded with oil, molasses or any other binder will fuse solidly in a heavy casting. The same core with a large vent hole in the center will clean readily from a similar casting. As an extra precaution some steel foundrymen wind a protective coating of fine wire around the small cores exposed to large sections of molten steel. A good wash for steel foundry cores consists of silica flour mixed to the consistency of cream with molasses water or a weak solution of any other water soluble core binder.

GENERAL

Wants Copper Finish

QUESTION

How can I obtain a copper finish on a gray iron casting?

ANSWER

Brannt gives the following methods for coating cast iron with copper: Scour the article with a pickle consisting of 50 parts of hydrochloric acid of 15 degrees Baume and 1 part of nitrate of copper. Then rub them with a woolen rag or a soft brush dipped in a solution of 10 parts of nitrate of copper and a like quantity of cupric chloride in 80 parts of nitric acid of 15 degrees Baume. After a few seconds rinse the articles in clean water and polish them with a dry woolen rag. This rubbing and con-

sequent polishing is continued until the copper layer is of the desired thickness.

The other is a dipping process and is as follows: The bath may be used cold as well as warm and consists of sodium sulphide, 10.58 ounces; 75 per cent cyanide of potassium, 17.63 ounces; acetate of copper, 12.34 ounces; ammonia, 7.05 ounces; and water 55 pounds.

The above bath is quite poisonous due to the potassium cyanide content, so care must be taken in its use and handling.

Sometimes a solution of copper sulphate is used, but unless care is taken in its application it will peel from the casting. It is good only for relatively thin coats of copper and used generally where the casting later is tinned.

Q & A

Annealing Castings

QUESTION

Have you any information available on annealing semisteel cylinders and pistons from ½ to 1½ inches thick?

ANSWER

Several foundries anneal or heat treat their castings. One firm that is engaged in the production of cylinder blocks and other automotive products heat treats its castings in a continuous oven, the cycle taking about 7 hours. The temperature at the peak is maintained at from 700 to 800 degrees Fahr. and the castings are held at this temperature for 2 hours. The remainder of the time is consumed in bringing the castings up to temperature and cooling.

Q & A

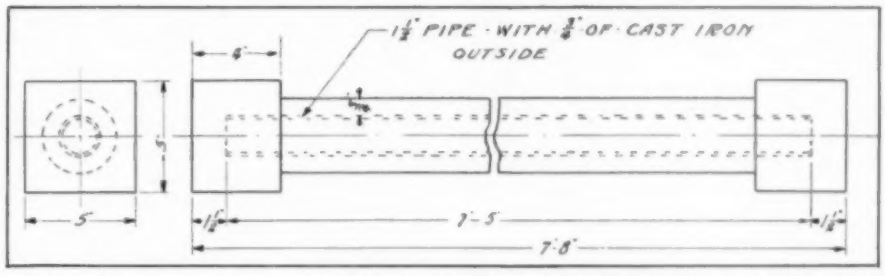
Enclose Tube in Casting

QUESTION

We have made two attempts to produce a casting 3 inches in diameter and nearly 8 feet in length with a 1½-inch steel pipe extending through the entire distance with the exception of 1½ inches at each end. In other words the tube is surrounded completely with iron. We filled the tube with sharp sand, plugged the ends and dried it thoroughly in the oven and then painted it with red lead before it was placed in the mold. The tube was supported by four chaplets top and bottom and by four on each side. The casting was poured from both ends, but the iron boiled violently and spewed out through three risers. We shall appreciate your opinion on how to get a satisfactory casting.

ANSWER

We are at a loss to understand what possible purpose a steel tube will serve inside a casting, where it is filled with sand and completely surrounded with iron. If it simply is inserted as a strengthening agent it will serve its purpose equally well if allowed to project through each end of the casting. If a solid end is required, plugs easily are screwed into place after the projecting ends of the tube have been cut off flush with the ends of the casting or even a short distance inside the ends. You run a serious risk in completely surrounding a plugged tube with molten iron. The least amount of moisture on the inside expands to a tremendous degree at such a temperature and either will split the pipe along the welded seam, or leak past the plugs if it does not blow them out. Even if the pipe is perfectly dry the air on the inside will expand to a point where it will find some avenue of escape. We doubt if you can tap and plug the ends of the pipe sufficiently tight to hold any gas, air or steam on the inside. We suggest you run the pipe through both ends of the casting and if necessary, plug the openings afterward. You will not find it necessary to fill the tube with sand. With only a ¾-inch thickness of metal the steel tube will resist both the temperature and the pressure. However, the tube must be clean, free from scale and rust and thoroughly dried. A coating of red lead prevents the clean surface from oxidizing. Even with all these precautions you probably will find it necessary to run a little metal through the risers to carry off the gas which inevitably will arise when the molten iron comes into contact with the skin of the pipe.



SIDE AND END VIEW OF PROPOSED CASTING WITH STEEL TUBE COMPLETELY ENCLOSED

Q & A

Coating Steel Inserts

QUESTION

What is the best material, preferably liquid, that may be used for coating steel shafts that are used for inserts in an iron casting?

ANSWER

A solution of silicate of soda often is used to coat iron or steel around which molten iron will be cast. The steel shaft first will have to be cleaned from any rust or oxides, etc., preferably by sandblasting. It is then given a coat of silicate of soda and allowed to dry thoroughly. Heating the shaft will assist materially in driving off any water of combination and prevent any guesswork whether or not the coating is dry. placing the shaft in the mold while still warm (just cool enough to be handled) and pouring the iron as soon as possible will prevent any moisture from the sand mold depositing on the shaft and causing blows. Also to have a good fusion between the steel shaft and the iron casting, the mold should be arranged so that a certain part of the first iron poured in can flow out. The iron that flows out will be cooled to some extent by the shaft, but it will have heated the shaft to a point that it will fuse with the following molten iron. Use of a higher gate than usual will allow the iron to overflow if the risers are maintained at the usual height.

Q & A

Show Fine Porosity

QUESTION

We are having trouble with some of our light castings which must be firm on the machine face but which show a fine porosity. This trouble does not show up on all castings, but we could save them if we could dip them in some solution which would cover the pin holes. Is there such a solution?

ANSWER

A solution of sal ammoniac could be used on the surface of the castings. This will rust the surface and fill the fine openings, and the excess rust may be removed with emery cloth. A thin paste of one of the advertized compounds for filling holes probably would work also. Since the porosity appears in some and not in other castings, it shows that there is some operation that should be checked up. Your molding and melting practices should be investigated carefully and the cause of your difficulty discovered instead of trying to employ a makeshift.

Problems in Nonferrous Founding

By Charles Vickers

Hard Spots May Be Iron

We are having difficulty making clean yellow brass castings for ornamental use. The defects cannot be detected until the castings are buffed when small hard spots become visible which cannot be eradicated by grinding down further into the castings. After being silver plated signs of spewing are nearly always noted the next morning. We melt in crucibles with oil fuel, using a formula of 70 copper; 27 zinc; 2 tin and 1 lead (new metal) which is melted in crucibles. We wonder if the spots are caused by copper scale, which leaves the copper when it is melted. Heavy unburnt copper wire is used. The castings are molded in San Diego sand; could the trouble be caused by sharp sand particles which have fallen out of cores and got mixed with the molding sand? Could you suggest a good flux or a different sand to overcome the troubles.

The small hard specks found in yellow brass castings is iron in 90 per cent of the cases where such occurs. Where that could come from in the present case we are unable to guess, after reading that it is all new metal. The scrap copper wire used in making the new metal will not be responsible for the hard specks in the castings, even if it was oxidized for it does not occur as hard spots. Even supposing the copper was not clean but carried a scale; this would be partly cupric and partly cuprous oxides. The cupric oxide, which is black, but not hard, would all turn into cuprous oxide, which is red in color. When the zinc was added, all this cuprous oxide, would be reduced to copper, leaving in the melt zinc oxide, which normally is white.

The light zinc oxide would come out of the melt as fumes, which on pulling the pot floats around the foundry like snow flakes. Much of this oxide stays in the metal and makes it pasty when the copper was badly oxidized. This pasty metal floats, and the skimmer pulls it off as a mushy mass. Now does this occur? Its effects are porous castings which show after buffing or machining; these are pin holes, not hard specks. Another sign is that the crucible gradually builds up on the sides and bottom with a mixture of brass and slag that cannot be melted, and is known as a *salamander*. Does this happen?

If neither of these phenomena occur, we are going to come out flat-footed with the statement if the hard spots, really are hard spots and no holes filled with buffing compound, then they are iron. We, of course, cannot state where it comes from. If turnings are being added, we would advise they be omitted for a number of heats, and then see if the hard spots appear. We do not understand what is meant by *spewing* is this different to *spotting out?* If it was the latter, then the hard spots would not be hard spots, but would be pin holes, into which acids had entered during plating operations, and had not been neutralized afterwards. The cure for this is to be careful in melting the copper, to prevent it sticking up into the flame.

In oil fired melting furnaces, often the copper wire will be punched down into the crucible and in this work it gets partly melted. Some of it may stick to the hole in the cover, making oxide, which is added to the charge. This must not happen at any time. Also keep a thin covering of glass on top of the molten copper. A ¼-inch thick cover is enough. Before adding the zinc drop in about one ounce of 15 per cent phosphor copper. The sand has nothing to do with the specks. As to a good flux, such is often helpful, and names of firms able to supply this material may be found in the advertising pages of THE FOUNDRY.

Unless the castings are thin like chandeliers, 2300 degrees Fahr. pouring temperature is too high. Decrease this from 100 to 150 degrees. The brass must be hot enough to flare some and look bright, and it must be poured with speed and decision to fill up the sprue heads, paying no attention to any spilling over. It takes a veteran brass molder to pour yellow brass that contains no aluminum and obtain good, sound castings.

Must Investigate Use

We have read a number of articles recently dealing with permanent molds, but have noted they all dealt with cast iron, or malleable iron. Can you advise us what has been done with brass? Is it a difficult problem, or so simple that nothing has been written about it? We shall appreciate any information you can give us in regard to casting brass in permanent molds.

Certain special alloys of copper have been and now are being used to a limited extent cast in what are called *permanent molds*, or dies as some like to call them. These alloys are types of aluminum bronze. Also silicon bronze can be cast in this manner, but as far as we are able to learn no castings of red brass, yellow brass or other alloys containing tin, lead and zinc, have ever been cast commercially by this method. It is a difficult problem, not a simple one, and that is the reason there is a dearth of literature dealing with this subject. The problem will have to be attacked in an entirely different manner to the present practice for iron, or even to that employed with copper alloys that can be cast in permanent molds. A large amount of experimental work will have to be done to obtain all the facts necessary to use permanent molds successfully.

There are a number of reasons for this divergence and they are of a metallurgical and chemical nature. As there is no way of evading them it will be necessary before any measure of success can attend efforts to eliminate sand molds on a commercial scale to learn the alphabet of the metals used for such everyday articles as plumbing fittings, bearings, ornamental service and the thousand and two other uses to which brass castings are put on a large scale. It would not pay to make the occasional casting in an expensive mold. We are writing now of castings of the easily machined red and yellow alloys, and not of those alloys so far cast in permanent molds, which are not fitted for the many classes of service to which ordinary castings designated by the word *brass* are put.

Many Factors Affect Production of Sound Iron Castings

Research Work Conducted by Various Groups Permits Close Control of Molding Sands in the Foundry

Part I

By R. W. Kurtz

THE most fundamental requirement for the production of quality castings is an engineering staff intimately familiar with foundry problems. In fact, this is so fundamental that it is likely to be overlooked or at least obscured in importance by the more evident and spectacular results, mistakenly credited to operating departments.

Engineering is the most fundamental of the applied sciences. It is the pilot of industry—of our own, the foundry industry. We hold that almost everyone prefers to do a task rightly if it may be done so, easily. Therefore the *primary* responsibility for both good and defective castings rests with the engineering departments.

Complex problems are only combinations of simple ones which yield to the application of a comparatively few fundamental principles. The efficient solution of an engineering problem consists first, in the development of the simplest possible layout, consistent with the accomplishment of the desired result; second, in the choice of materials of construction most economically suited to the layout; and third, in the selection of details most favorable to construction with these materials.

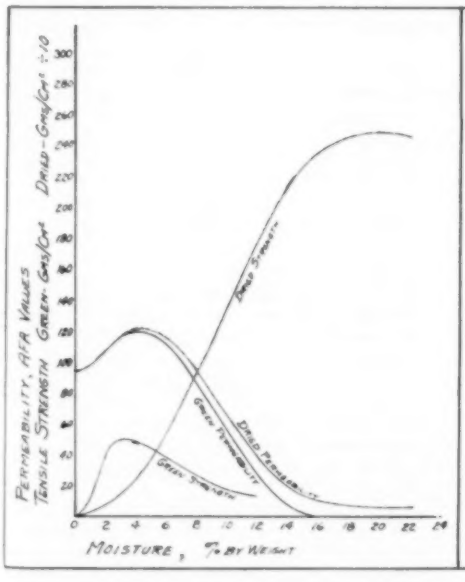
The third step is by no means the least important. On these details hinge many possible economies, and sometimes the success of the whole venture. The proper design of a casting requires a great deal of study and specialized ability. An excellent discussion of this subject appears in *Research Group News*, April, 1929.

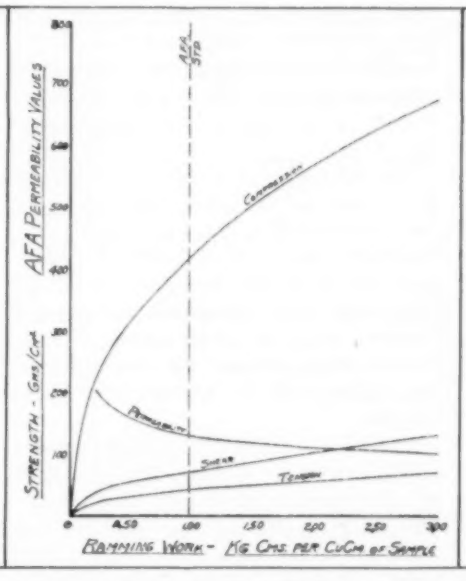
To enumerate every possible factor of design involved in the accurate production of castings would be beyond the scope of this article. An attempt is made, however, to briefly outline the four principal considerations which enter into an efficient casting design:

Economical distribution of metal to secure necessary strength with minimum weight. Cast metals are

Control Production

CONSISTENT production of sound castings requires careful attention to a number of factors such as design, molding, melting, cores and sand condition. Neglect of any one of these factors soon is reflected in defective castings. From time to time articles have been published giving data on the importance of attention to the various factors. In this series of two articles, which is abstracted from a paper presented at the Chicago convention of the American Foundrymen's association, the author describes some tests and principles employed in controlling production in an Ohio foundry. Mr. Kurtz is superintendent of the Newcomerstown, O., plant of James B. Clow & Sons.





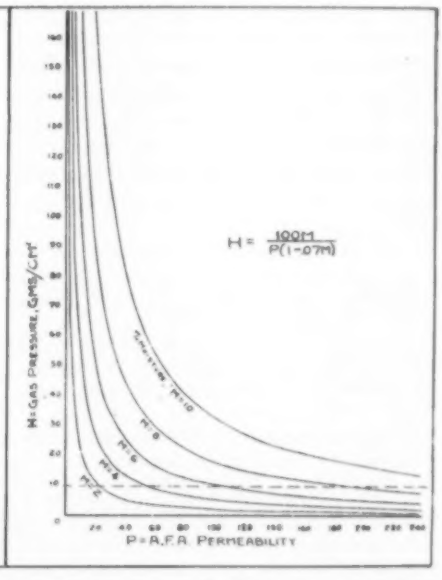


FIG. 1—EFFECT OF MOISTURE ON STRENGTH AND PERMEABILITY OF A TYPICAL MOLDING SAND. FIG. 2—EFFECT OF RAMMING ON GREEN SAND STRENGTH AND PERMEABILITY OF A TYPICAL MOLDING SAND. FIG. 3—HYPOTHETICAL EFFECT OF VARIOUS COMBINATIONS OF MOISTURE AND PERMEABILITY UPON MOLD GAS PRESSURES

most efficient in compression.

Uniform distribution of metal to avoid cooling strains and shrinkage cavities. This means the careful proportionment of each rib, fillet, boss, flange, lug, etc.

Simplification of molding operations. This is achieved by the allowance of ample draft, by use of straight parting lines, and by anticipating means for the proper holding and venting of cores, when the use of cores is necessary. In the case of complicated or large unwieldy designs, it sometimes is advisable to simplify the molding by casting certain members separately, especially parts subject to wear or breakage.

Simplification or elimination of machining operations. This is accomplished by the use of cored holes, cast inserts, or chilled surfaces. Also by the provision of ample clearances and the allowance of minimum finish.

To develop intelligently proper tools and methods for quantity production in sand molds, much information about sand is required. Comparatively recent research work has enabled foundrymen to test and control their molding sands with a greater degree of accuracy than was possible, or even considered necessary, in the past.

The sand tests which are regularly employed at our foundries are as follows:

A. F. A. Seive Analysis. This analysis is valuable for estimating texture, particularly of new sands and facings.

Fusion Cone Number. This value is useful in estimating the refractoriness of core sands, facing sands and daubing clays.

Strength. All of our molding materials are tested in tension.

Moisture. Percentage by weight is determined at 110 degrees Cent.

Permeability. Permeability by A. F. A. machine, tensile strength and moisture tests are made daily or oftener in control work. Lower limits only are set on permeability and strength, but both upper and lower limits are set on moisture.

For the test values to have a practical meaning, the methods of determination must be reliable and the influence of mutually related variables must be thoroughly understood.

As a result of our sand test work the following general statements are given:

A rough relationship exists between the tensile, shear, and compressive strengths of practically all rounded-grain sand mixtures, green or dried, and with or without organic binders. Results indicate the shear strength to run from 1.5 to 2.5 and the compressive strength from 8 to 15 times the tensile strength.

Tensile and shear tests share an advantage over compression and transverse tests in that the former may be conveniently used for the full range of materials, molds to cores. This greatly simplifies testing and permits true comparisons between mold and core strengths, which hardly would be possible with molding sand tested in compression and baked core mixtures broken by tensile or transverse loading.

The strength, if possible, should be determined on the same specimen used for permeability. A standard permeability specimen, 2 inches in diameter and 2 inches long, of baked oil sand core may withstand an applied load as high as 5000 pounds. Suitable testing devices for strengths of this magnitude are elaborate and expensive.

There is of course, a still broader indictment than inconvenience against all compression and transverse tests. The values obtained are entirely dependent on the *shape* of the test specimen. Actual failure is always by shear or tension, or both. Compression and transverse tests merely introduce the complication of shape or form.

A method which we developed for tensile determinations after we had experienced difficulty in getting consistent results with methods which break the specimen across a section perpendicular to the direction of ramming will be described in the second section of this article.

A ball hardness tester is valuable for determining and interpreting the properties of actual molds and cores. This may be accomplished with a fair amount of accuracy by testing the strength and permeability of samples which have been rammed just enough to give hardness values corresponding to those found in actual practice. One device will be shown later.

The strength or cohesiveness is dependent on six variables which follow:

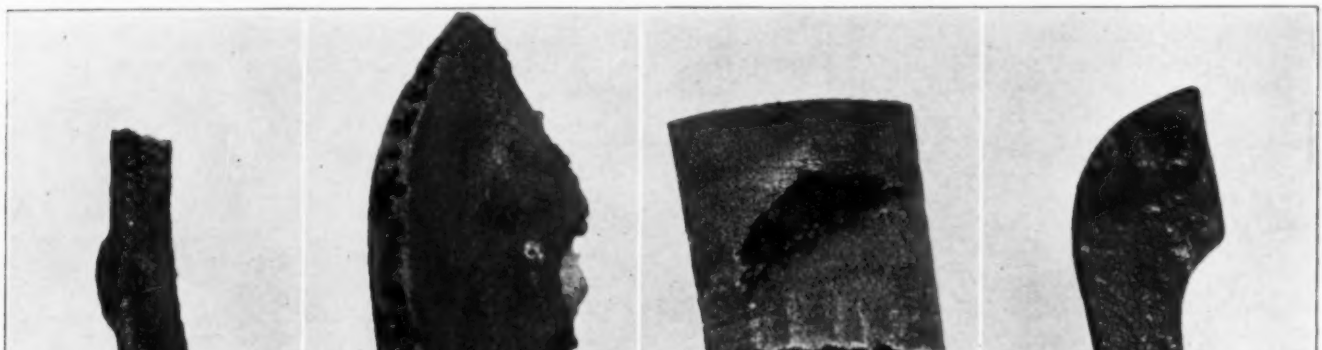


FIG. 4—FOUR CLASSES OF DEFECTS DISCUSSED: *A*, SCAB INCLUSIONS; *B*, MOLD OR CORE GAS HOLES; *C*, LIQUID SHRINKAGE, AND *D*, IRON OXIDE REACTION

Amount of free moisture. The maximum green and dry strength of any sand mixture is developed by widely different moisture contents. The moisture which develops maximum green strength *usually* is slightly less than that for maximum permeability and for that which gives the best tempered working condition. A typical relationship is shown by curves given in Fig. 1. The proper moisture for any sand varies almost directly as the clay content.

Amount and kind of bond. Up to 20 per cent clay substance, the maximum green and dry tensile strengths of straight sand-clay mixtures vary directly as the amount of the particular clay substance used. Clay substance improves the strength of all mixtures except those containing binders, such as core oils, which are absorbed and rendered ineffective by traces of clay and silt.

Size and character of sand grains. In general, the smaller or more nonuniform the sand particles, the greater will be the green and dry strength.

Intensity of mixture. The more intimately the material is mixed,

the more strength will be developed. The proper mixing of sands with plastic substances like clays, requires a rubbing rather than a tumbling action, so that the clay may coat the grains instead of merely fill the void spaces.

Intensity of ramming. The curves in Fig. 2 show how the strength and permeability of a green molding sand are influenced by the ramming work per unit volume of specimen.

Drying temperature, if dried. Above a certain minimum temperature, depending upon the material, long periods of slow drying give higher and more consistent strength values, than short periods at high temperatures.

The maximum green to maximum dry strength ratios vary widely for different clays. Values have been found ranging from 1 to 30 to 1 to 200.

Permeability values determined on uniform sizes of round sand grains vary directly as the square of the grain diameters. With non-uniform grain sizes the permeability relationship is complicated and probably the simplest conception is that the permeability of any sand cannot be greatly different than that of the finer 30 per cent which fills the void spaces of the coarser portion.

Permeability of a sand-clay mixture of any moisture content is not improved greatly by drying. Microscopic examination shows that when wet mixtures, such as loam muds are dried, the clay particles are deposited in a manner tending to produce an *unconnected* system of void spaces, in place of a connected system, which is essential for free gas passage. Of course, little permeability is required when the free moisture has been completely removed by drying and the net result is a greatly decreased possibility of blow holes.

Sufficient plasticity for loam sand work is developed with about 15 per cent moisture and 15 per cent clay substance. Drying cracks begin to develop when the clay substance exceeds 25 per cent, especially in connection with excessive moisture or high oven temperature.

Cohesive value and cleaning properties of dry and wet surfacers, or facings, may be determined best, so far as we know at this time, by pouring a deep, open, test mold. It is important that facings do not scab off and become entrained in the metal. The solid inclusions themselves are often not as harmful as the internal gas pockets which are caused by volatiles in the mixture. See *A* in Fig. 4 shown on the preceding page.

The *blowability value* of a sand may be defined as the gas pressure, measured in grams per square centimeter, generated when molten iron at 2450 to 2500 degrees Fahr. is poured on the standard permeability specimen. The device used to measure this pressure will be described in the second part of this article.

The pressure is a function of the volatile matter and permeability of the sample and may be calculated approximately from the expression:

$$\frac{K_w W}{P(1-CW)} \quad (1)$$

where P represents the permeability, W, the weight of volatile-bearing-substance (v. b. s.) in the specimen, K_w, a constant which depends on the rate of formation and density of the gases generated, and C, a variable which expresses the effect of the condensate that collects in the cooler portion of the specimen and thus reduces the original permeability.

The value of C ranges from practically zero for dried or coarse, open sands to 0.06 for fine or compact moist sands. For rough estimating purposes C may be taken at an average value of 0.04 when dealing with free moisture, and as zero for dried specimens. Experimentally determined values of K_w for several common substances are given in the Table I.

Substituting these values the general expression (1) becomes, for free moisture:

$$\frac{60W}{P(1-0.04W)} \quad (2)$$

where W=total grams used for specimen times per cent moisture, and P is the American Foundrymen's association permeability value of specimen.

The total weight of a specimen usually runs from 150 to 190 grams. If we assume an average value of 170 grams, expression (2) may be written, approximately:

$$\frac{100M}{P(1-0.07M)} \quad (2a)$$

where M is the per cent moisture by weight. See curves of Fig. 3 for hypothetical effect of various combinations of moisture and permeability.

The interesting part of the expression is the denominator. In practical parlance this term means that due to the accumulation of condensed moisture in the cooler portion of the mold, the initial permeability is reduced at the rate of some 4 per cent for each gram of moisture in the specimen, or, roughly, 7 per cent for each per cent moisture by weight. Thus in green sand work it is important to use the vent rod freely and to pour rapidly so that the ferrostatic pressure may be developed at a greater rate than the mold gas pressure. On the other hand, it is of no great value to have an excessive vent area on the surface of a flask because the mold gas which actually escapes through the vent holes ordinarily represents such a decreased portion of that generated near the face of the mold, that relatively little final exit area is required.

In the case of dry sand molds or cores, the amount of volatile-bearing-substance (clay, seacoal, flour, oil, etc.) often is known in per cent by volume and the general expression (1) may be written more conveniently for dried specimens:

$$\frac{K_v V}{P} \quad (3)$$

Where $K_v = K_w$ times specify gravity, and $V = \dfrac{\text{Grams used for specimen}}{\text{Grams mixture per c.c. v.b.s.}}$

Due to the relatively low values of K, dried molds and cores never give trouble from *blowing* except when the vent passage is closed off completely or when the drying is imperfect. If the cope is cut away enough to observe the action of the metal, some blubbering or *kicking* will be found in a large percentage of green sand molds.

Table I

Pressure Values for Various Materials

Substance	Specific Gravity (as used)	K_w (by weight)	K_v (by volume)
Free Moisture	1.00	60	....
Combined Moisture	.....	10	....
*Seacoal	0.84	5.5	4.5
*Wheat Flour	0.46	10.5	5
*Corn Starch	0.62	11	7
*Dextrin	0.52	14	7
*Molasses	1.30	4	5
*Glutrin	1.25	5.5	7
*Glue	1.07	3	3
*Linseed Oil	0.93	6	5.5
*Pulverized Rosin	0.62	6.5	4
*Pulverized Pitch	0.54	4	2

*Combustible substances have a flash pressure which precedes and is from three to six times as high as the pressure which follows and which is given by the values of above table.

Offers Novel Discussion *on Core Floating*

By John D. Babbitt

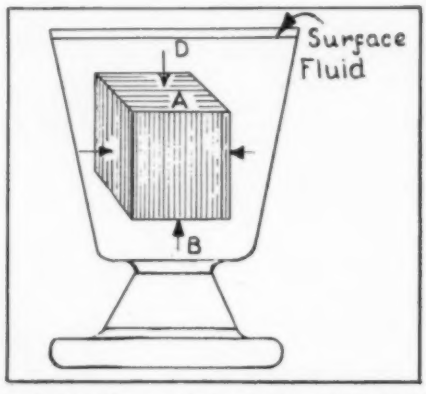
SOME time ago in an article by W. J. Clark, published in THE FOUNDRY, he referred in particular to the floating of cores. I am inclined to differ with him in his conclusions. As I understand the law of floating bodies (buoyancy) a core with perfectly vertical sides, standing absolutely perpendicular in a mold with its lower end resting on the bottom of the mold, and so sealed that no iron could enter under it, would not float. Of course, there could be a little joker in the deck at this point of the problem, for it might be said that if the core so set floats, it is certain that iron is under it and if the iron is under the core, removing the core from its original setting, it unquestionably did float.

The test that Mr. Clark proposed, "Place a core endwise in or on the bottom of a ladle of metal, hold it down tight, let it go and see it jump" is not a conclusive test, because it could not be supposed that in so crude a test, the core would be perpendicular nor be seated so perfectly on the rough ladle bottom as to absolutely exclude the entrance of iron under it. Also, one would perhaps try to hold the core down with a skimmer or rod, and in removing it no doubt would disturb the core slightly and therefore, rob the test of its value.

Among many molders there seems to be a lack of understanding regarding the matter in question. All sorts of notions are abroad in the land. The author frequently refers to his old books and refreshes his memory on some of the natural laws of physics and chemistry. The laws of the universe as given to us by Archimedes, Avogadro, Mariotte, Gay-Lussac, Newton and others still remain.

It is well to remember at all times that while we may understand a law or a principle fundamentally, yet as we endeavor to interpret and apply it in practice, we sometimes are confused and go astray. This is not strange, as many times we deal with a problem that is not simple but complex. Let us now consider the law of floating bodies and see if we can understand it as it operates in the foundry.

I will quote more or less from Ganot's *Physics* concerning pressures on a body immersed in a liquid. He taught that where a solid is immersed in a liquid, every portion of its surface is submitted to a perpendicular pressure which increases with its depth. If we imagine all these pressures resolved into horizontal and vertical pressures, the first named are in equilibrium. The vertical pressures are obviously unequal and will tend to move the body upwards. Let us imagine a cube immersed in a mass of water as shown in the accompanying sketch and that four of its edges are vertical. *The pressures upon the vertical faces being clearly in equilibrium we need only to consider the pressures exerted on the horizontal faces A and B.*



THE FORCES ACTING ON THE IMMERSED OBJECT ARE RESOLVED INTO HORIZONTAL AND VERTICAL PRESSURES

The first is pressed downwards by a column of water whose base is face *A* and whose height is *AD*. The lower face *B* is pressed upwards by the weight of a column of water whose base is the face itself and whose height is *BD*. Therefore, the cube is urged upwards by a force equal to the difference between these two pressures which later is manifestly equal to the weight of a column of water having the same base and the same height as the cube. *Consequently this upward pressure is equal to the weight of the volume of water displaced by the immersed body.*

An apparent inconsistency between the latter sentence in italics and the previous one in italics, may be suggested by the thought that the upward pressure should be the same, since the volume displaced by the immersed cube would be the same whether the cube was suspended so as to be entirely surrounded by fluid, or was at rest on the bottom of the vessel containing the fluid so that no water could enter under it. My answer is that I believe not, because in setting the cube on the bottom we have strictly speaking, no longer a cube to reckon with. That is, one face of the cube has been eliminated so that the static pressure is no longer exerted on the lower face, but is exerted downwards on the upper face and laterally on the four sides, which are in equilibrium. If this reasoning is correct there would be no upward pressure, but on the contrary, there would be a pressure downward of 14.5 pounds (atmospheric pressure) until the fluid had covered the cube and after that, the pressure downward would equal the weight of the column of fluid over the upper face of the cube.

The author made the following experiments. A box 6 x 6 inches square and 8 inches deep with a water-tight bottom was made. A stick 6 inches long and 1 inch square then was made. Care was taken to make the sides of the stick parallel and the ends trimmed at right angles. A little grease was then smeared on one end of the stick and this end was seated firmly on the bottom of the box. Water then was introduced slowly and carefully through a hose in such a manner that there was little disturbance. The vessel was filled to overflowing which covered the stick 2 inches in depth. The stick did not float and was left in same position for over two hours. The thought then came, that inasmuch as the bottom of the stick had been sealed with grease, thereby excluding water and

(*Concluded on Page* 679)

The FOUNDRY Family Photograph Album

Upper Left

L. McARTHUR
Stewart Die Casting Corp., Chicago

Lower Left

G. P. ROGERS
Steel Founders' Society of America, New York

Upper Right

J. V. PROSHEK
Cuyahoga Foundry Co., Cleveland

Lower Right

J. A. SHEPARD
Shepard-Niles Crane & Hoist Corp., Montour Falls, N. Y.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

PROPOSED GOVERNMENT SPECIFICATION

For Silica Mold Wash

General Specifications

There are no General Specifications applicable to this specification.

Grades

This specification covers two grades of silica mold wash as shown in the accompanying table.

Material

The manufacturer is given wide latitude in the selection of raw material and the processes of manufacture, so that he may furnish products of highest quality.

General Requirements

Both grades of material covered by this specification shall be suitable for use in steel foundry work by mixing with water or binder mixture for washing the surfaces of sand molds.

Detail Requirements

Silica mold wash shall conform to the requirements shown in the accompanying table.

Requirements For Silica Mold Wash

Grade	Per Cent to Pass a 100-Mesh Sieve	Per Cent to Pass a 200-Mesh Sieve	Per Cent Silica	CC of Sediment 10 minutes after Agitation
			Minimum	Maximum
A	.....	100	99	2.5
B	100	90	98.5	.....

Grade *A* silica mold wash shall be a pure silica flour, finely powdered and air floated to remove such particles as will separate in water emulsion.

Grade *B* silica mold wash shall be suitable in every respect as a steel mold wash but can be made use of when a wash of less pure silica content is all that is required.

Methods of Inpection and Tests

Containers shall be opened at random and samples taken and tested to ascertain that the material conforms to the requirements of this specification.

Abstracted from a tentative specification published by the Federal Specification Board, Washington.

(*Concluded on Data Sheet No.* 776)

PROPOSED GOVERNMENT SPECIFICATION

For Silica Mold Wash

(*Concluded from Data Sheet No.* 775)

Test for Determination of Silica—Weigh 1 gram into a weighed platinum crucible, moisten with water, add 2 drops of sulphuric acid and about 15 cubic centimeters of hydrofluoric acid, evaporate to dryness, heat and weigh, repeat with 2 drops of sulphuric acid and 5 cubic centimeters of hydrofluoric acid, evaporate to dryness, heat (to be certain of complete volatilization) and weigh. Difference is SiO_2 (method open to slight errors but these are negligible on *pure* silica).

Sediment Test—A 5 gram portion of sample shall be placed in a 100 cubic centimeter graduated comparison tube and the volume brought to 100 cubic centimeters by the addition of cold water. After thorough agitation and mixing, 2.5 cubic centimeters of sediment shall settle to the bottom of the tube in not less than 10 minutes.

Dry Sieve Test—(a) Sieves used in this test shall conform to the U. S. Standard Sieve Specifications or A. S. T. M. E-11-26.

(b) The sieving operation may either be performed by mechanical shaker or by hand, with the coarsest sieve on top, the various sieves assembled in sequence named, with dust pan on bottom. Place 10 grams dry sample on coarsest sieve, cover, and then shake not more or less than 5 minutes. Weigh samples retained on each sieve and in pan, express weight in percentage of material passing through each sieve.

Packing and Marking of Shipments

Unless otherwise specified material shall be delivered in strong paper or cloth bags, of about 100 pounds net weight. Each container shall be plainly marked with the container or purchase order number, name of manufacturer, the material, net weight and grade.

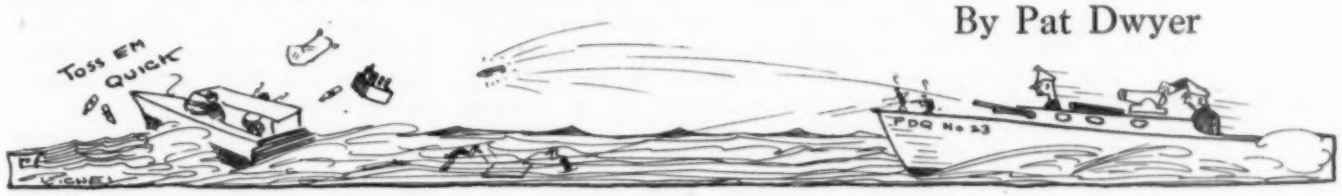
Notes

Contracts and purchase orders should state what grade of material is required.

When submitting bids, bidders should furnish a two pound sample of the silica mold wash they propose to furnish. Such samples should be furnished in tin containers and should have the name of the manufacturer or contractor as designated in this specification distinctly marked thereon.

Bill Comments on Pipe Connections

By Pat Dwyer



SOMETIMES," Bill remarked reflectively and apropos of nothing in particular, "sometimes I have half a mind to take a whirl at the thing myself. 'Tis a trifle risky but not any more than lots of other occupations. In fact a man runs more risks every day in crossing a few streets or in taking a pleasure spin on any highway on the blessed Sabbath day. Also, from what I have been told by—er—gentlemen who profess to have inside sources of information the racket pays good money."

"All right," I replied, "I'll bite. At the present moment I am half asleep and certainly this night is too hot to stage an argument. If you want to tell me about it instead of running around in circles, go ahead. You have the time, the place and the opportunity. On the other hand, my brave lad, if you think you have aroused my curiosity and that I shall not give you a minute's peace until I have wormed your guilty secret out of you, you have sadly mistaken my heroic power of resistance. I am not wormy. Strictly among ourselves, as between man and beast you can whirl away until you are as dizzy as one of these whirling Dervishes. The simile occurred to me spontaneously, you might say, and I think in this instance it is particularly apt. These whirling lads whirl away for an hour, but they never get anywhere. Spin away, my boy, if you think it will relieve your mind."

"Well," said Bill, "I'll tell you. I met a fella the other day who wanted to sell me a power boat." "What for?" I naturally inquired. "For 6000 bucks," Bill answered jauntily. "What do you think he wanted to sell it for, a song?" "Not to you," I said, "if he ever heard you attempting to warble. You know perfectly well what I meant, but if you insist on a blueprint and set of specifications, why did this man solicit you to buy, purchase or otherwise acquire for your own exclusive use this certain lot, piece or parcel of sea going equipment?"

"Why," said Bill, "because he needed the money."

"Listen," I said, "and this is absolutely the last peep you'll get out of me even if you get down on your old yellow knees and implore me with tears in your eyes—dribbling from the end of your long nose—to ask you again. I only hope you'll buy the thing and the first time you go for a ride it will break in two and drown you far enough from the water intake to prevent you from contaminating the water supply of the city. For the last time I ask you, what plea did this man present that would induce you to consider the purchase of a power boat?"

"Curiosity," Bill remarked kindly, "once killed a cat. Be calm. Restrain yourself. Little did I think when I came here this evening that I was to be subjected to a gruelling inquisition. Shocking, I calls it. I pass you out a small item of information and before I can say a second word you jump on me with teeth and claws for the remainder. For an exceedingly small monetary consideration, to wit, 2 cents, I would refuse, Sir, to go any farther."

Deep and dignified silence on the part of the party of the second part.

Bill smoked reflectively in silence for a few minutes and then resumed as unconcernedly as if he had just stopped to light his pipe.

"This lad I was telling you about said he was going to Europe for the summer. He did not want to tie the boat up any place, because, as he explained quite indignantly, he was afraid some of these here low down rum running black guards would steal her. You could not trust any of 'em. He had been in the racket himself for the past two years and he ought to know. This little baby of his was the fastest thing on the lake between Toledo and Ashtabula and he would not think for one red hot minute of parting with her, but the plain fact of the matter was he had to have a larger boat to serve his public adequately. He deeply appreciated the confidence his customers reposed in him and begad, Sir, he would show 'em it was merited. Also, a nice sense of honor, a virtue mark you, above rubies, was the foundation of his business success. He was properly jealous of his reputation as a man who always delivered the goods.

"'You can take this boat,' he said, 'and with any kind of luck you can clean up more jack before the lake freezes over than you could make in the foundry in 40 years.'"

Here Bill lapsed into silence. He deliberately and aggravatingly filled and lighted his pipe and smoked away for a few minutes. I waited patiently for him to continue, but apparently he regarded the episode closed. Curiosity, I am thankful to say—as I mentioned previously—is not among the failings for which I will have to render an account some day, but dash it all, I hate to be carried a certain distance and then left dangling between heaven and earth like Mahomet's coffin. "Bill the Rum Runner, eh?" I said, "I can see the head lines in the paper one of these days after the preventive officers drag you ashore with one long ear shot off. FORMER FOUNDRYMAN TIRED OF RUNNING HARD IRON TRIES HIS HAND AT RUNNING HARD LIQUOR. I shall follow your career with interest and perhaps some fine Sunday I shall take a run down

SUNDAY IS JUST A DAY OF INNOCENT RECREATION

to the pen to see you in your nice striped suit like a zebra in a circus wagon."

"Your knowledge of our justly famed penal institutions," Bill replied, "is on a par with your knowledge of many other subjects. The state spends a lot of money in catching these here shifty monkeys and naturally after they are pinched it treats them with the greatest kindness and consideration. From warden to humblest keeper, every man Jack in the institution feels under a deep moral obligation to discharge these men at the end of their term in as good condition as when they entered. Their diet is supervised carefully. Hours and working conditions are regulated to give just the proper amount of exercise. The good old rule *early to bed and early to rise* is enforced rigidly. No Sunday work is tolerated. That is a day of rest which the yeggs may spend contemplating (a) methods of escape, or, (b) future activities in their chosen profession. Quite properly, the state will not have them disturbed on that day by visitors." "You are out of luck, then," I told him. "Certainly I shall not waste a day during the week to see you picking oakum or trying to gnaw your way out of the cage. Let me have the boat while you are gone. Will you?"

"I ain't gone yet," Bill reminded me pointedly, "and what's more, young-feller-me-lad, I ain't going. I have been looking up some statistics on the rum running industry and I find that the percentage of loss is extremely low. The figures admittedly are incomplete—the gentlemen engaged in the business show a decided reluctance to having their books audited—but a fairly accurate estimate shows that only 0.002 per cent of the boats are apprehended, only 0.0001 per cent of the liquor crossing the lake is confiscated and only 3.117 per cent of the confiscated liquor is destroyed.

"The so-called hazard of the enterprise has been greatly exaggerated. Since navigation opened this season, one boat load of contraband has been captured coming into Cleveland. This does not mean that the preventive officers are idle. On the contrary they are so exceedingly active and so free in their use of fire arms, that owners of pleasure boats are scared stiff. According to newspaper reports, the draft in the Detroit river has been reduced 6 (six) inches on account of the amount of lead spilled into it since prohibition went into effect. Rum runners shot during that time—0, innocent passersby—3½."

"Where do you get this 3½?"

"Oh," Bill replied carelessly, "I suppose that means one of 'em was only half shot.

"I was up that way a short time ago and I heard some peculiar stories connected with the business of booze peddling. One citizen told me of an incident which reminded me of the words of the psalmist: *All men are liars and the truth is not in them.*

A GILT EDGED PERSONAL GUARANTEE WITH EVERY PACKAGE

"Apparently some foxy lad in the long ago had succeeded in putting over a sharp deal in which the singer was left holding the bag, hence the sweeping condemnation.

"The citizen who told me the story did not take in quite so much territory. He confined his remarks to the Ananias-like gift of a certain colored gent. If he ever gets his eye—and his big muscular hands—on this gent, said gent is due for a line of comment that will raise blisters on his hide. Yes sir! By the shin bones of Vulcan, he will just about burn him up!"

"Why all the ferocity?" I inquired. "Did this colored person sell him a boat?"

"No, said Bill, "he did not sell him a boat, or the Fisher building or the fountain at the lower end of Belle Isle. Don't be so impatient.

"This gentleman, hereafter referred to as *A.B.*, drove home one evening after the hard day's work and was told that a pullman porter was waiting to see him, but would not state the nature of his business.

"'Well, let him stick around a little longer,' says brave *A.B.* 'I am fed up with seeing all kind of people all day and I'll see no more until after I have had something to eat. Sound the jolly old mess call and lead me to the festive board.'

"Refreshed and fortified, he interviewed the visitor, who confided in the most guarded tone that he had a parcel for him. *A.B.* naturally asked to see it and was told it was down at the railroad station. According to the porter's story a certain gentleman in Toronto, well known to *A.B.* had secured a limited supply of real genuine stuff and had asked the porter to deliver a dozen bottles to *A.B.* The porter was to collect $100 cash and after deducting commission, insurance, freight, etc., was to turn the remainder over on his next trip East to the good Samaritan in Toronto. 'If it's all de same to you Boss,' the dusky courier suggested, 'we kin drive down to de station an' you kin tote de stuff home in yo' cah.' 'Fair enough,' quoth *A.B.* 'Lets's go.' Arrived at the station, the porter went out in the train shed and returned with two packages. He explained that the consignment had been split in two for ease of handling. To prove that all was as represented he obligingly removed part of the cover on one package and lifted out a bottle for *A.B.'s* inspection.

"Application of the tests usually employed in such cases convinced *A.B.* that the goods were *O.K.* and furthermore that the porter was a jolly good fellow. He paid the $100 and in addition tipped him handsomely, placed the two packages in his car and drove home.

"The following day while glancing through the paper his eye happened to light on the phrase *a pig in a poke* and a tiny germ of suspicion was planted in his mind. Could it be possible that the pullman porter had put something over on him? Was the porter, really a porter? True he had worn a porter's uniform, but what did that prove? *A.B.* reflected that on one occasion he himself had worn the costume of a Spanish bull fighter at a masquerade but that was no evidence that he was a member in good standing of Matador Local No. 3, Seville.

"'I'll just take a look at the inside of these packages,' says he to himself, 'and if I find what I am afraid I shall find, I'll just naturally crucify that bird when I catch him.'

"He found what he expected to find, all right. The first package contained just one bottle, no more no less. The remainder of the container was filled with a mixture of gravel and sawdust to make the correct weight. The second package was completely filled with the same innocent mixture."

"Did he ever catch the counterfeiter?" I inquired.

"Not yet," said Bill, "but he has hopes."

"Now, that's off your mind," I insinuated gently, "perhaps you'll tell me about the boat." "I met another lad on the same trip," Bill continued, without heeding the interruption, "who said he should like to know how cast iron pipe fittings from 1 to 6 inches are made in foundries that specialize in that kind of work. He was curious about the details of patterns, coreboxes and arbors and if the cores are made in green or dry sand. Some pipe makers still prefer to use dry sand cores in all miscellaneous small fittings, while other men make all the cores in green sand. Local conditions, character of available sand and personnel of the working force are important factors that exert a bearing on this point. The dry sand users claim that the little extra expense incurred in the preparation of these cores is only a reasonable premium to pay for better and greater production. Pattern equipment is the same irrespective of whether the cores are made in green or dry sand. The only exception is the so called shell pattern employed for making both core and mold. This type of pattern equipment is confined almost entirely to the production of soil pipe fittings and therefore, properly speaking, does not enter the present discussion.

"According to the standard method the pattern is split horizontally through the center and mounted either singly or with one or more duplicates on a pattern plate. Although a symmetrical pattern may be mounted in such a manner that either cope or drag may be rammed on it, the usual practice is to mount the drag half of the pattern on one board or plate and the cope half on a second plate. In this manner the labor of two men and two machines can be used to its full productive capacity. This type of pattern is employed irrespective of whether dry or green sand cores are used.

"Dry sand cores are made in halves in metal coreboxes and dried on flat plates. After they are dried, they are rubbed to a bearing and pasted in pairs. In some instances two half coreboxes are employed to form a complete core. This applies particularly to the small sizes and is a prerequisite where the cores are formed with a sand blowing machine. Some of the cores may be placed on flat plates, while others must be supported in drier shells.

"In practically all instances the pattern and core are designed in a manner that will dispense with chaplets. On *T*'s the three prints hold the core firmly in the mold. Elbows of various angles are mounted in pairs in such a position that the core in one automatically resists the pressure exerted against the other. In most of the smaller fittings a combination core is made to fit at least two and frequently a greater number of mold cavities. These cores usually are made from an oil sand mixture and require no rods or arbors. In some localities other types of core binder are employed quite satisfactorily.

"Green sand cores are made in hinged metal coreboxes. Cast iron arbors made up of backbone and a surprisingly small number of transverse wings are employed for reinforcement and for anchors on which the core rests in the prints. For a *T* or other shape with more than two core prints, the arbor is made up of two sections that lock at some convenient point and may be taken apart for removal from the casting. Elbows are molded in pairs with a single core from which the skimpy arbor may be removed quite easily.

"In practice the open hinged corebox is placed flat on the bench or pair of horses and filled with sand. The arbor is pressed into the soft sand in the drag half and then the remainder of the sand is pressed down firmly with the hands. The flat surface on each half core then is scraped clean and the two halves of the box are raised to a vertical position face to face. The corebox then is lowered back on the bench with the drag part underneath. The cope half is rolled back out of the way and the green core is lifted out of the drag part of the box. In some instances the core may be grasped by the projecting ends of the arbor. In other designs, particularly elbows, a special type of lever is inserted at certain points in the arbor ends so that the core may be balanced and lifted from the bench to the waiting mold." "I suppose," I said, "you soon will be setting up as an authority on power boats?" "The old bulldog breed, eh?" Bill grinned. "Well, I'll tell you. I did not buy the boat. I learned next day that this honest citizen had told me the truth, but unfortunately, not the whole truth. He was planning to quit the racket temporarily and go to Europe, but that was only incidental to escape going to the pen. The boat had been confiscated the day before and he wanted to turn an honest penny by selling me a *dead horse!*"

TEN YEARS OLD, BUT SMALL FOR ITS AGE

Appointed Manager

C. B. Schneible has been appointed manager of sandblast sales for the American Foundry Equipment Co., Mishawaka, Ind., and J. D. Alexander has been appointed manager of sand preparation equipment sales for the same company. Mr. Schneible has been associated with the American company since 1918, and in the past years has specialized in sandblasting. Mr. Alexander has been with the company since 1916. Before his recent appointment, he was direct factory representative specializing in sand cutting and conditioning equipment.

C. A. Anderson has been appointed sales manager of the Ford Chain Block Co., with headquarters at the general offices and works located at Second and Diamond streets, Philadelphia.

Phosphorus Causes Hard Spots in Bearing Bronzes

Excess Phosphorus in Metal Is Oxidized Forming Fusible Slag which Attacks and Fuses to Sand and Refractories

By James Silberstein

AN ALLOY which is used extensively for bearings in this country contains about 80 per cent copper, 10 per cent tin and 10 per cent lead. A small amount of phosphorus, generally ranging from 0.10 to 0.50 per cent, is added for deoxidizing purposes.

It frequently occurs that machining of bearings of this alloy and alloys of similar composition is rendered difficult by hard spots in the metal. The tool runs into a tiny sand or slag spot with the result that the cutting edge is dulled, and the tool has to be removed for grinding. This, of course, results in a loss in time and labor, and if the number of sand and slag spots is great, it is often cheaper to scrap than to attempt to machine the bearing.

Sand and slag spots may vary in size. They may be so large that they are easily visible to the naked eye, or so small that they are only visible with the aid of a magnifying glass. The sand and slag spots which are visible on the surface of the bearings naturally are removed in the foundry before the bearings are skipped, but the spots which are below the skin are not detected until machining.

Reveals Defects

When the bearings later are being machined, it may be found that some of them have such a large number of hard spots that they are rather difficult to machine, while others are almost free from hard spots and, therefore, easy to machine. An investigation will show that those bearings which had the greatest number of hard spots visible on the surface caused the most trouble in machining. Hard spots are caused by the condition of the metal. If hard spots have been formed, they are to be found not only upon but also below the surface. A poor condition of the metal, from the machining point of view, is characterized by the occurrence of many hard spots located upon the surface as well as beneath the skin. If a bearing has several visible hard spots, it is not a good practice to remove these by grinding and ship the bearing. The machining department in all probability will reject the casting after having spent time and labor in machining, and it would have been wiser and cheaper to scrap the bearing in the foundry before grinding.

Forms Hard Spots

Metal condition which causes the formation of hard spots is excess phosphorus content. The claim frequently has been made, that the condition of the molding sand has an influence on the formation of hard spots. While it will not be denied that the use of a sand having higher refractory properties may give better bearings than a more fusible sand, it is difficult to see, why some heats should result in good bearings, while others result in poor, when using the same grade of sand.

Reasons for the addition of phosphorus to the metal are its deoxidizing action and the fusibility of the products formed as a result of this action. Because of the last mentioned property the slag particles, formed in the metal on deoxidation, melt together to larger particles and rise to the surface of the metal bath. This is of advantage since it allows the use of a high percentage of scrap metal or scrap metal only in the heat without having any undesirable effect on the fluidity and casting properties of the alloy. It goes without saying that phosphorus is oxidized not only by the metal oxides in the metal bath, but also by the oxygen of the air at the surface of the metal.

Unfortunately, the fusibility of the slag formed upon oxidation of phosphorus has a disadvantageous effect, since the slag easily attacks and fuses to sand and refractories. This was demonstrated forcibly by the following experience in furnace operation:

A furnace was used continuously several days for melting bearing bronzes with a phosphorus content of 0.5 per cent. After the run it was found that the refractory lining had been corroded severely. A similar run on bronzes having approximately the same chemical composition but a phosphorus content of only 0.10 per cent or less showed the attack on the lining was much smaller. That such difference in corrosive action as caused by phosphorus had not been noted before was due to the fact that such a long run of high phosphorus containing alloys had not been made previously, and that the action is not readily noticeable after a run of a few heats only. The loss in phosphorus on melting increases with increasing phosphorus content of the metal. A parallel to this is the well-known fact that the loss in zinc on melting brass increases with increasing zinc content of the brass. Phosphorus lost by the metal oxidizes and forms slag, which readily combines with constituents of the refractory lining to form fusible products. As a result the lining of the furnace is corroded and eaten away, the severity of the attack depending on the phosphorus in the metal.

Phosphorus Oxidizes

Something similar, though naturally on a much smaller scale, happens in the mold. Part of the phosphorus oxidizes (this part is greater, the higher the phosphorus is in the metal) when the metal comes in contact with air during pouring. The phosphate formed then acts upon sand particles of the molding sand, which become fused on the metal or carried below the surface of the metal by its flow. In this way hard spots are formed. Since phosphate slag is hard and brittle, it may form hard spots without the aid of sand, but as a matter of fact, the appearance of most hard spots shows the presence of sand. The sand particles are often

much larger than the specks of slag to which they have fused and they appear therefore as sand spots. There also are spots which clearly show the slag.

Hard spots sometimes have been claimed to be due to inverse segregation. Inverse segregation, or the migration of a low melting point constituent towards the skin of the metal on solidification, is promoted by a slow rate of cooling. In the case of bearing bronzes the segregating constituent is a copper-tin-phosphorus eutectic, which is quite hard. The observation sometimes can be made when pouring bearings, that an exudation forms on the top of the riser shortly after the metal has set. Chemical analysis showed that the exuded metal in one such case had tin content of 22 per cent, and a phosphorus content of 1.3 per cent while the alloy poured was an 80 copper; 10 tin, and 10 lead deoxidized with 0.4 per cent phosphorus.

It is a well established fact that the hardness of a bearing is greater on the surface than below and in the center of the metal; and that the difference in hardness increases with increasing thickness of the bearing. Inverse segregation easily explains this condition. However, local hard spots are difficult to explain as being caused by inverse segregation, since they are distributed irregularly on the surface. If caused by inverse segration they would be located where the rate of cooling is lowest. Furthermore, the occurrence of sand and slag particles cannot be a result of inverse segregation. It may be mentioned in this connection that the phosphorus content has a decided influence on inverse segregation (this holds true also for iron), the segregation being more pronounced at higher phosphorus content. This, in conjunction with the fact, that increasing phosphorus content hardens the alloy, explains the greater skin hardness of bearings high in phosphorus. The greater hardness of the skin naturally renders machining more difficult, but it has not the damaging effect on cutting tools that sand and slag spots have.

Produce Steel Castings

(*Concluded from Page* 650)

the slag and metal to this status. While recognizing that it is impossible to obtain a condition of absolute equilibrium between metal and slag in an open-hearth bath, with this qualification the condition aimed at is designated as one of equilibrium. It is a condition wherein the bath not only is almost free from the effects of iron oxide, but the slag is of the composition and consistency that it wields but little influence on the metal underneath it, acting only as a covering to protect the metal from the furnace atmosphere.

Action going on within the metal bath during the final stages of the heat is between the carbon in the iron, presumably in solution with the iron, and the last traces of iron oxide (FeO) also in solution with the iron. Just why carbon attacks this iron oxide more readily than does manganese which is residual like the carbon, is not clearly understood. However, evidence is not wanting that when carbon and manganese are present in a bath of metal which is in a condition of superheat, with slight amounts of iron oxide also present the latter will be attacked by the carbon with much more avidity than it is attacked by the manganese, although manganese is generally considered to have a greater affinity for oxygen than carbon has. This action has been described by one of the most able steel makers as the deoxidation of the bath by the carbon. As he recognized that the manganese equaled if it did not surpass the amount of carbon he too recognized that the affinity of carbon for oxygen increases with higher temperatures.

As the heat progresses lumps of lime come to the surface, and if they do not dissolve readily the operator should break them up with a bar. Add spar only when the condition of the liquid slag is such that the spar will not make it too thin. A slag that has received too much spar will cut the ladle lining excessively, and may attack the stopper rod and cause a loss of metal. A slag rich in magnesium oxide, as when portions of the bottom come up, oftentimes attacks the ladle lining and stopper as greedily as one having an excess of acids, or one that is excessively hot and has been sparred too freely.

While waiting for the bath to lose the last few points of excess carbon, tests must be taken often for the purpose of following the drift of the carbon, and to keep in touch with changes taking place in the temperature of the metal. The condition of the slag also is noted while taking the tests. When the metal temperature reaches the point which precedent has shown to be what is wanted for pouring the molds without loss, and there are still a few points of carbon to be worked out, the volume of the flame should be reduced so that the metal and slag will not become hotter than is wanted or required. No single factor is more important than temperature control. Nor is there any phase of steel making which requires more attention, skill, and thought than is required in controlling the temperature of the metal so that the various heats conform to this requirement. Whether the tapping temperature varies or not, will depend on the class of the work as well as whether at one time low carbon is wanted, and at another high carbon is wanted.

Tapping the Heat

Now, if 0.25 per cent is the carbon aimed at in the product, the heat should be ready to tap soon after the bath attains this amount of carbon. When the fracture of a test shows about 0.25 per cent carbon, and all other conditions are as desired, the ladle is called and immediately a substantial amount of spiegeleisen is added. It has been found that 15 pounds of spiegel per ton of metal in the bath will go far toward deoxidizing the metal. Not only does the manganese contained in the spiegel deoxidize the metal, thereby precluding any further loss of carbon during the interval which elapses before the heat is tapped, but the carbon contained in the spiegel usually increases the carbon in the metal by the amount that the added spiegel contains. Usually about 15 minutes will elapse from the time the ladle is called until the metal has been transferred from the furnace to the ladle. If the spiegel raises the residual manganese by 0.10 per cent, and if the carbon remains fixed or rises a point, these results taken together or singly presuppose the fact that the heat has been properly made, and the quality is high. On the other hand should the manganese contained in the spiegel be all used up in deoxidizing the metal and no increase result, and should the metal lose carbon during this short interval, this fact can be taken as indisputable evidence that the heat is below par, and that an error has been made.

Made British Agents

Pneulec Ltd., Maneking road, Smethwick, near Birmingham, England, has been given the exclusive manufacturing and selling right in the British market for special sand, mold, core and casting handling machinery manufactured by the C. O. Bartlett & Snow Co., Cleveland. Included in the products are conveyors and elevators of many types, screens, magnetic separators, sand conditioners, pug mills, blenders, sand hoppers, gates, feeders, core crushers and cupola charging units.

The Shakeout

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¶ Control Methods Pay

THE foundry industry offers a field where much improvement may be made in advancing and bettering plant control. Many of the rank and file of the industry have no faith in control methods. True it is, that in some plants one method is emphasized almost to the exclusion of others. Some foundrymen make one certain thing their fetish and maintain that so long as that one material or operation is under strict control all will be well in the plant and casting losses will be maintained at a minimum.

MEN employed in the foundry are critical observers and a great many times are not of sufficient education to judge correctly. They have a pet aversion. A great many of them pick control as the one thing in which they have no faith for the simple reason that they do not and cannot understand the principles involved. This is especially true of members of the old school. They take the attitude that good castings were produced before control methods were known and that if they got along without them before they can get along without them now. These men cannot appreciate how modern methods have improved the product and have reduced the cost of production. They refuse to be convinced of the worth of these methods and can be made to abide by them only when coerced. Even then they do not accept them. They tolerate them. Such a condition is detrimental to the foundry industry.

FARSEEING men of the industry have recognized this fault in the structure of the foundries of the country and have adopted methods to correct it. The introduction of young men into foundries who are willing to learn, who are not prejudiced and who are capable of thinking problems out for themselves will do much to remedy the situation. Apprentice training has received its share of discussion in the past few years and much is being done in teaching young men the value of control methods in the foundry. It will take time to realize a dividend on the investment as far as the industry as a whole is concerned, but in years to come the return will be ample.

¶ Large Costs of Little Lots

EVERYONE is familiar with the economy of large scale production. The era of home manufacture of necessities of daily life has passed. The corner cobbler has followed the village wagonmaker into history, and wasteful methods unavoidable under such manufacture have been eliminated. Only in buying will a comparison with uneconomic practices be found.

W. J. Early Sons Foundry Corp., Pittsburgh, recently sent to THE FOUNDRY office a circular from one of the firm's sources of supply which states the fallacy of small lot buying in clear terms. This announcement says:

> It costs us too much to furnish you with supplies. We have to carry excessively large stocks so that we can ship any order the same day as received. You make us deliver small lots expensively. It usually costs us as much to fill a small order as a large one. We have to employ enough warehouse men to take care of the peak load of orders which usually comes the middle of every week. Other days we are not so busy, but we have to pay our employes regardless. We have to maintain enough office force to keep our records in such shape that we can answer instantly any question you may ask us by 'phone. If we fail, you quit buying of us.
>
> If you would buy all your supplies of us and not split them among so many competitors, your orders would be larger and would often be in standard packages which we can handle without expensive repacking. If you would anticipate your wants and give us more time to fill them, we could reduce our prices still further. At first you did not like the chain stores, but better merchandise at lower prices put the old fashioned grocery store out and now you must pay cash in advance and carry your groceries. Do you remember when there was a grocer's salesman calling at your home several times every week? Our methods are as wasteful as the old corner grocery and if you do not help us improve them, in the end you may be sending cash with your truck to some chain supply store not yet planned. Your problem is ours. What is the cheapest and best method of marketing the articles we sell that you need? The present method is too expensive and cannot continue.

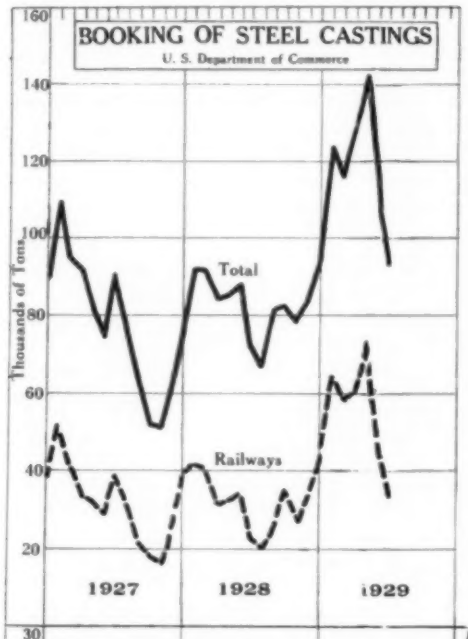
Many buyers of castings could learn much from the principles here laid down.

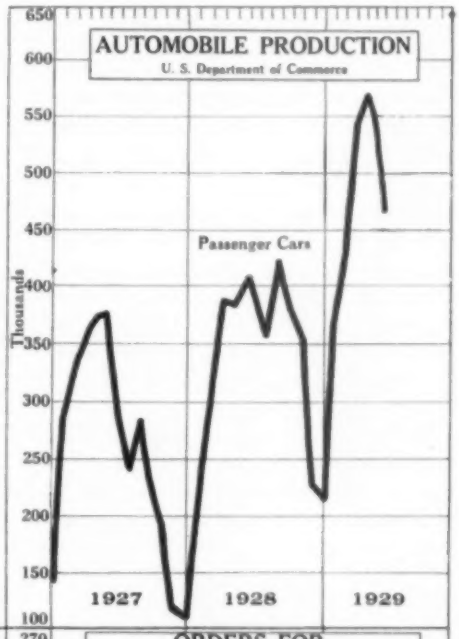
Trade Trends in Tabloid

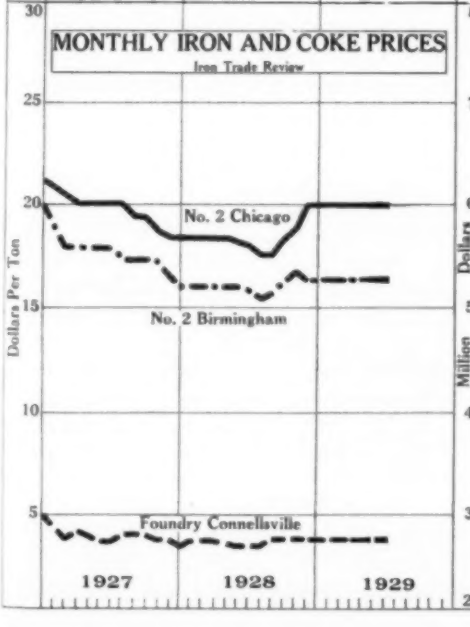
A SLIGHT recession is noted in castings demand, although foundry operations have not been adversely affected. This is in line with the normal summer slackening, but the depression in the curve is less pronounced than in many previous years. The half yearly output of automobiles is 47 per cent ahead of last year and the total breaks all previous records. Trucks have stepped ahead of passenger cars in the rate of increased output. Malleable castings orders have declined slightly, but still are in excess of production figures. Steel foundry operations show a small reduction in the early part of July, but the rate still is well ahead of the first few months of the year. Sales of electrical machinery during the first six months of 1929 were 22 per cent ahead of the corresponding period of 1928. Building construction awards are less than the totals of last year, but the demand for builders sundries, plumbing goods and supplementary products is only slightly affected. Production of steel ingots, an index of activity in many diversified lines was 17 per cent ahead of last year when the six-month totals were compared. Machine tool sales for the period mentioned stood above 300 per cent with the average of 1922, 1923 and 1924 as a basis of 100 per cent. Freight car loadings continue to run at record volume. Increasing prices of farm products indicate improved outlook.

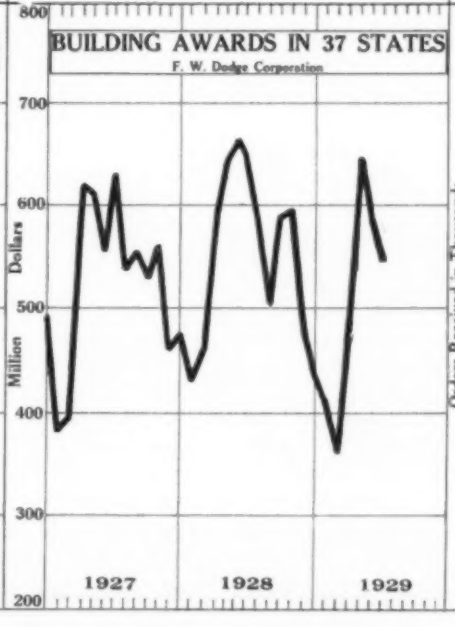
RAW MATERIAL PRICES
July 24, 1929

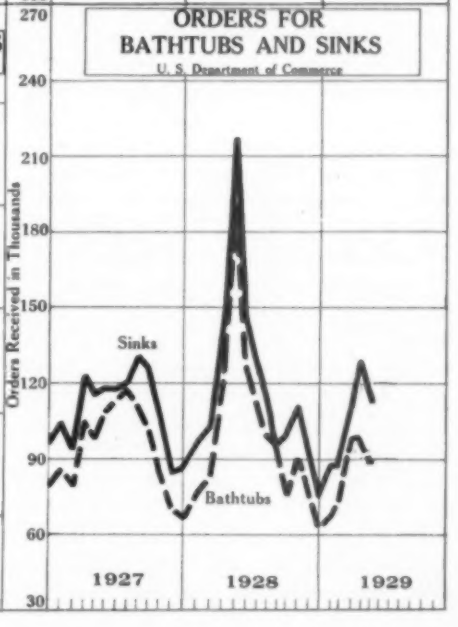
Iron	
No. 2 foundry, Valley	$18.50
No. 2 southern, Birmingham	14.50 to 15.00
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	21.76 to 22.26
No. 2 foundry, Buffalo	19.50
Basic, Valley	18.50
Basic, Buffalo	18.50
Malleable, Chicago	20.00
Malleable, Buffalo	20.00
Coke	
Connellsville foundry coke	$3.75 to 4.85
Wise county foundry coke	4.25 to 5.00
Scrap	
Heavy melting steel, Valley	$18.00 to 18.50
Heavy melting steel, Pitts.	18.50 to 19.00
Heavy melting steel, Chicago	14.75 to 15.25
Stove Plate, Buffalo	12.75 to 13.25
Stove plate, Chicago	11.50 to 12.00
No. 1 cast, New York	13.00 to 13.50
No. 1 cast, Chicago	14.50 to 15.00
No. 1 cast, Philadelphia	16.00 to 17.00
No. 1 cast, Pittsburgh	15.00 to 16.00
No. 1 cast, Birmingham	14.00 to 15.00
Car wheels, iron, Pittsburgh	16.25 to 16.75
Car wheels, iron, Chicago	13.50 to 14.00
Railroad malleable, Chicago	16.50 to 17.00
Agricultural mal., Chicago	15.50 to 16.00
Malleable, Buffalo	18.00 to 18.50
Nonferrous Metals	Cents per pound
Casting, copper, refinery	17.37½
Electro, copper, producers	18.00
Straits tin	47.25
Lead, New York	6.75
Antimony, New York	8.50
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	17.00 to 17.50
Zinc, East St. Louis, Ill.	6.80











Personal

Herbert D. Templin, formerly in charge of foundries in Passaic and Newark, N. J., has been appointed foundry superintendent of the William T. Barker Foundry, Bridgeton, N. J., which recently was purchased by the Ferracute Machine Co., Bridgeton. William T. Barker, formerly owner of the foundry, now is taking a vacation and has announced no plans for the future.

A. W. Newby, formerly vice president of the Huber Mfg. Co., Marion, O., has been elected president and general manager. He succeeds S. E. Barlow, now chairman of the board.

M. D. Baughman has been appointed manager of the operating department, in charge of plants and production at Ellwood City, Pa., and Warren, O., plants of the Aetna-Standard Engineering Co., Youngstown, O.

H. B. Hanley, formerly connected with Whitehead Bros. Co., New York, has become associated with the American Laundry Machinery Co., Rochester, N. Y., as metallurgist in the foundry department.

L. H. Beyer, for many years connected with the American Radiator Co. in Buffalo and New York as manufacturing department executive and director of purchases, has become sales director of the Dunbar bearing bronze division of the Buffalo Bronze Die Cast Corp., Buffalo.

William L. Ditges has been elected vice president in charge of engineering of the Mackintosh-Hemphill Co., Pittsburgh. He has been associated with that company since 1916, during which time he occupied the positions of chief draftsman, assistant chief engineer, and chief engineer.

W. R. Duda has been appointed chief engineer of the Mackintosh-Hemphill Co., Pittsburgh, to succeed W. L. Ditges. Mr. Duda has been connected with the Mackintosh-Hemphill Co. for the past 11 years, for several years as assistant chief engineer.

George M. Schulthess has been elected president of the Garrett Brass & Aluminum Foundry Co., Garrett, Ind. Other officers of the company are Alfred J. Bahr, vice president; D. B. Van Fleit, secretary; C. H. Heinzerling, treasurer, and George H. Tuck, general manager.

Dr. John Chipman and John D. Strong have been appointed to the staff of the department of engineering research of the University of Michigan, according to Prof. A. E. White, director of that department. Dr. Chipman will devote his time to the study of steel melting practice. He was formerly assistant professor of chemistry at Georgia School of Technology. Mr. Strong will study pyrometer practice. He received the degree of master of science at the University of Michigan last year.

S. G. Butler, formerly assistant personnel manager of the Buick Motor Co., Flint, Mich., has been appointed to a similar position for the Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich. He succeeds David J. Grant who recently resigned to become industrial commissioner at Monroe, Mich.

J. G. Pelding, for 11 years general manager of the Lombard Iron Works & Supply Co., Augusta, Ga., was elected president, July 3, to succeed the late George R. Lombard, founder of the company. Mr. Belding has been with the company 39 years. Other officers are: Treasurer, W. A. Rigsby; secretary, S. A. Fortson, and superintendent, H. M. Leitner.

Herbert F. Perkins has been elected president of the International Harvester Co., Chicago, to succeed Alexander Legge, retiring after seven years in that office to become chairman of the new federal farm board appointed by President Hoover. Mr. Perkins began his service with the McCormick Harvesting Machine Co. in 1898, and has been with the International Harvester Co. since its organization. For seven years he has been first vice president.

I. Edmund Waechter, formerly in charge of the Illinois Foundry Co., Springfield, Ill., has been made general superintendent of the L. N. N. Foundry Co., Cleveland.

Sends Greetings

WESLEY Lambert, president of the Institute of British Foundrymen has sent the following message of goodwill and inspiration to foundrymen throughout the world:

"When replying to the toast of the Institute of British Foundrymen, so graciously proposed by Sir John Dewrance, I expressed its indebtedness to the various authorities, committees, companies and individuals for the help they gave toward making the International congress the success it undoubtedly was. THE FOUNDRY has afforded me a second opportunity of renewing those thanks, and of communicating to the foundry industry, wherever it be located, a message of goodwill.

"It is patent to everybody connected with the Institute of British Foundrymen that the congress has both awakened dormant interests and created new ones. At the moment it carries the hallmark of success, and with success comes a testing time. Thus, my first message to the industry is to avoid at all costs any backward swing of the pendulum.

"Though the international activities may remain static for a few years, yet there is ample work for all of us in advancing the technique of our industry, by co-operative effort through our scientific and technical associations. I suggest that, wherever possible, the basic character of the industry should be stressed; its underlying scientific principles emphasized; its craftsmanship and historical development clearly defined. There is much work yet to be done in the systematic recruitment and training of the personnel of the foundry, whether they be juvenile or adult entrants.

"Finally, the contacts made during the last few weeks must be welded. Foundrymen will learn that their newly-found friends are efficient and courteous correspondents, therefore a special effort should be made to carry out those conversational promises made. Courtesies of this character are invariably reciprocal and are conducive to all that is best in international amity and business."

Obituary

William Dill, 62, owner of the Dill Foundry Co., Rushville, Ind., died July 7, at the City hospital. Mr. Dill was a graduate of Purdue and Cornell universities.

William Klugel, 55 years old, secretary and treasurer of the Standard Foundry Co., Dayton, O., died July 16.

Walter MacGregn, general superintendent of the Wheeling Mold & Foundry Co., Wheeling, W. Va., died in the Ohio Valley General hospital, Wheeling, recently, following an operation.

Albert J. Wessel, 30 years old, secretary and treasurer of the Reliance Foundry Co., Cincinnati, died at St. Mary's hospital, Cincinnati, July 14.

Readers Comment

Note—Material appearing under this head does not necessarily reflect the opinion of THE FOUNDRY or of its editors.

TO THE EDITORS:

In a recent issue of THE FOUNDRY, C. J. Freund discussed the subject of apprentices for foundry work. In this discussion three questions were considered: (1) Should apprentices be trained? (2) Where should they be trained? and (3) By whom should they be trained?

Mr. Freund answered the first question in the affirmative and recommends the shop foreman as the man to give the instruction to the apprentices and suggests the shop or factory as the place to learn the trade. In the following paragraphs I shall consider the practical and technical training of patternmaker's apprentices.

Apprentices are needed to take the places of those who leave the trade because of death, disability, old age, or financial failure. In this age of complicated labor-saving machinery a large number of patternmakers are required each year, making necessary the training of apprentices to supply this demand. This fact generally is conceded, and answers the first question.

In the consideration of the place where apprentices should be trained and who should teach them, three methods are suggested: (1) Complete course of instruction in the production shop. (2) practically complete course of instruction in school shop, and (3) a Co-operative course of practical instruction in the production shop and technical instruction in mathematics and drawing in the school.

Complete training on the job has the advantage of training under actual working production conditions and of having a practical man for instructor. It has the further advantage of providing immediate employment when apprenticeship is complete. In some cases it has the disadvantage of poor instruction because of a disinterested foreman or one who is so rushed with production that no time is allowed to teach the young apprentice. As a rule, a shop foreman is not a trained teacher and does not present the instruction in a logical and organized way. Jobs are taken as they come and a great deal of experience is gained in some kinds of work and on other kinds none at all.

Almost complete training can be given in a well equipped school shop and if the teacher is a man with practical experience the instruction should be of the best. Since there are no production problems the whole time of the instructor is given to organizing the course and presenting it to the students in a logical and comprehensive way. Each student gets a great variety of work and should be well equipped for various kinds of jobs when his work is complete. Along with his practical work, a student gets mathematics and drawing, necessary to make him a finished patternmaker. He is then ready to begin earning money for his employer as soon as he enters the production shop and the expense of carrying him through the unproductive years of his apprenticeship is saved.

Some employers have a co-operative arrangement whereby the practical instruction is given in the production shop and the technical instruction is given in a trade school. Apprentices attend evening classes or part-time day classes where mathematics, drafting, and science are given, including possibly, special shop instruction. This plan has most of the advantages suggested in the first two plans and few

Foundry Association Directory

American Foundrymen's Association

President, S. T. JOHNSTON, S. Obermayer Co., Chicago; secretary-treasurer, C. E. HOYT, 222 West Adams street, Chicago; technical secretary, R. E. KENNEDY, 222 West Adams street, Chicago.

Associated Brass Founders of New England

President, J. A. DUNCAN, Wm. Duncan & Sons Co., 166 Liverpool street, East Boston, Mass. Meeting the fourth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. HIRE, Hire Foundry Co., Peoria, Ill.; secretary, FRANKLIN WHITEHEAD, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, DAVID G. ANDERSON, Western Electric Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co. 2563 W. Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, CARL S. NEWMAN, Union Mfg. Co., New Britain, Conn.; secretary CHARLES S. PARKER, Charles Parker Co., Meriden, Conn. Meetingmeetings are on second Friday of each month in various parts of the

Detroit Foundrymen's Association

President RUSSELL M. SCOTT, Packard Motor Co., Detroit; secretary, WILLIAM J. MUHLITNER, Great Lakes Foundry Sand Co., Detroit. Meetings third Thursday in each month at appointed place.

East Bay Foundrymen's Association

Secretary O. R. MOLLER, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Gray Iron Institute

President, WALTER L. SEELBACH, Forest City-Walworth Run Foundries Co., Cleveland; Secretary, ARTHUR J. TUSCANY, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, R. R. FAUNTLEROY, Moline Malleable Iron Co., St. Charles, Ill.; secretary ROBERT E. BELT, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association

President WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn N. Y.; secretary, WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue, New York.

Newark Foundrymen's Association

President, J. L. CARTER, Sachs-Barlow Foundries, Inc., Newark; secretary W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President CARL S. NEUMANN, Union Mfg. Co., New Britain, Conn.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio Foundries Association Inc.

President, C. C. SMITH, Toledo Steel Casting Co., Bancroft and Smead avenue, Toledo, O.; secretary-manager, E. F. SCOTT, 418 Penton building, Cleveland.

Philadelphia Foundrymen's Association

President, C. F. HOPKINS, Ajax Metal Co., Philadelphia; secretary EARL SPARKS, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association

President, L. W. MESTA, Mesta Machine Co., Homestead, Pa.; secretary-treasurer WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association

President, F. W. KIRBY, John Deere Spreader Works, East Moline, Ill.; secretary-treasurer, J. P. BOADEN, Union Malleable Iron Co., East Moline, Ill. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

St. Louis District Foundrymen's Club

President, HORACE R. CULLING, Carondelet Foundry Co., St. Louis; secretary-treasurer, LEO J. FILSTEAD, John C. Kupferle Foundry Co., St. Louis.

Southern Metal Trades Association

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Steel Founders' Society of America

President, J. E. MCCAULEY, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; managing director, G. P. ROGERS, Graybar building, New York.

Tri-City Technical Council

Chairman F. V. SKELLEY, Tri-City Railway Co., Rock Island, Ill.; treasurer, MAX SKLOVSKY. Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

President, WILLIAM HOPPENJANZ, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, WILLIAM E. LOBERG, American Hoist & Derrick Co., St. Paul; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. W. ORPHAN, Lake Union Foundry Co., 1703 Westlake avenue, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

of the disadvantages encountered.

Training mechanics in a trade school is no longer an experiment. It is being done successfully in many of our large cities. The primary business of any school is the giving of instruction and better results should be secured in an institution of this kind where trained teachers and well equipped class rooms are available. Teaching is a profession similar to the practice of law or medicine. When we have a job of teaching to be done it is just as natural for us to turn to the school as it is to go to the doctor's for medical treatment or to the lawyer for legal advice.

The David Ranken, Jr., School of Mechanical Trades in St. Louis has a well equipped shop for giving instruction in patternmaking. This shop is in charge of an instructor who has had extensive experience as a teacher and as a practical mechanic. Graduates from this shop have been very successful in the trade and employers frequently inquire at the school when in need of patternmakers.

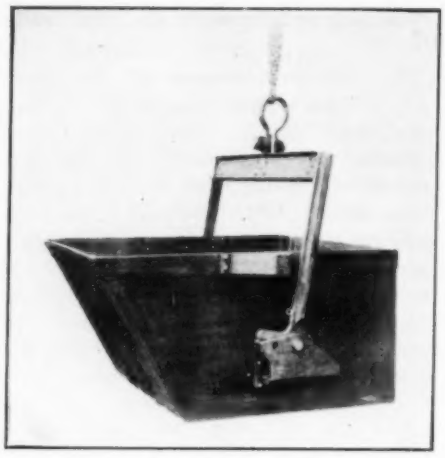
Apprentices learning their trades in the production shops can attend evening classes to good advantage for special shop instruction or courses in mathematics and drawing. . There are at the Ranken school 42 plumbers' apprentices, 21 electrical apprentices, and 17 apprentices from the street railway company, all taking part-time training. These are being sent in organized groups. Many apprentices are attending the school as individuals and paying their own tuition.

Similar work is being done in many other schools in the country both public and private. Employers of apprentices should consult the school authorities in their local communities if they are interested in apprenticeship training.

O. H. TURNER
Superintendent,
The David Ranken, Jr. School of Mechanical Trades,
St. Louis.

Bucket Is Rugged

Edgar E. Brosius Inc., Sharpsburg, Pa., has placed a dump bucket on the market. This bucket is of rugged construction and is adaptable to foundries for handling sand, coal, ashes, etc. The scoop is welded, the sides, bottom, and ends being made of steel plate reinforced around the top with heavy bar iron and on the corners with angle iron. The trunnions and tipper element are steel castings riveted to the scoop and the sides of the bail are steel castings or rolled bars. The top of the bail is made of channels or



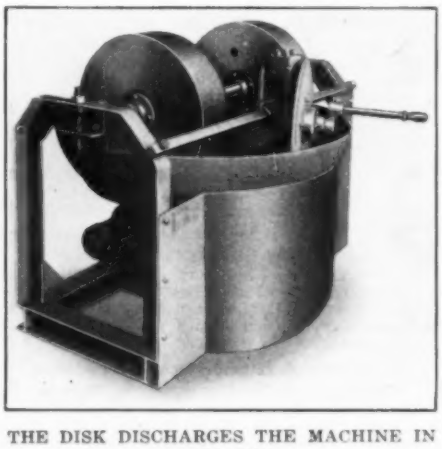
THE BUCKETS ARE OPERATED MANUALLY

bars. The buckets are operated manually. A bucket may be controlled entirely by the craneman and it is not necessary for him to see it when dumping or hooking as it may be dumped on uneven surfaces or slopes and cannot be unlatched in midair.

Sand Mixer Is of the Muller Type

Clearfield Machine Co., Clearfield, Pa., recently has placed a muller type sand mixer on the market. The frame of the machine is made of structural steel, and a heavy cast pedestal is mounted on the frame, supporting the revolving pan. The pan is mounted on a bearing made by the Timken Roller Bearing Co., Canton, O., which also is supported by the pedestal. Gear reduction unit is mounted on roller bearings and is housed in a casing which is integral with the main pedestal. The motor is mounted on an extension of the pedestal casting.

The pan is revolved by a pair of spur gears the larger of which is attached directly to the bottom of the pan. The method of construction confines the driving mechanism to a small amount of space. The discharge side of the machine is covered from rim to floor by a steel-plate guard which extends from one end of the frame to the other. That arrangement tends to prevent the sand from working under the machine and aids in protecting the driving mechanism from dust and dirt. Ready access to the drive parts may be had from the rear of the machine.



THE DISK DISCHARGES THE MACHINE IN 20 SECONDS

Mullers weigh 1600 pounds each and are cast hollow. If more weight is required the mullers may be filled with a material to give the desired weight. The mullers may be lifted to any desired height above the bottom by screw jacks mounted on the end frame and are free to rise any additional height required by the material in the pan. They are mounted on roller bearings.

A disk, shaped to the curve of the pan and free to revolve with the stream of material is mounted on the discharge side of the machine. It also serves as a scraper throwing the material in the pan against the muller. When the tempering operation has been completed, the operator throws forward the handle which is attached to the disk. This causes the outer edge of the disk to swing out against the edge of the pan where it catches the material and throws it from the machine into a receiver. It is claimed that this method of discharge empties the pan in about 20 seconds and also tends to aerate the sand.

Attends British Meeting

Francis Hodgkinson, consulting mechanical engineer of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., recently went to Europe on an extended business trip. Mr. Hodgkinson attended the June meeting of the British Institute of Mechanical Engineers at which he delivered a paper on "Journal Bearing Practice." He also attended the meetings of advisory committee No. 5 of the International Electric Technical commission.

Plan Ohio Boat Trip

Ohio Foundries Association Inc., Cleveland, is planning an interesting program for its annual meeting. The association expects to make a boat trip of the Ohio river, leaving Cincinnati and journeying to Ashland, Ky., and return. Special plant visitation features will be provided at Ashland. Technical sessions will be held on board the boat while enroute. According to present plans, the trip will be made shortly after Sept. 15.

Steel Foundry Expands to Meet Demand

(*Concluded from Page* 642)

built by the millwright staff of the foundry. In fact this ingenious crew of all around handy men assisted in building the plant and erected and installed practically all the equipment. The large ladle is dried in a horizontal position with the mouth up against a brick wall through which the flame from an oil burner enters the ladle.

Small ladles are heated on the inside to a bright red over a series of small openings in the upper face of a circular hollow brick structure 30 inches high and 8 feet in diameter. The brick chamber is divided into four sections and each section is served by an oil burner inserted at a tangent from the outside. The flame completely fills the chamber and flows up through the openings into the inverted small ladles. The chambers may be operated independently or all together to dry and heat 4, 8, 12 or 16 ladles.

In addition to several tumbling barrels the cleaning room is equipped with a large sandblast room and table made by the Pangborn Corp., Hagerstown, Md., and one of the new combination tumbling barrels and sandblast outfits manufactured by the American Foundry Equipment Co., Mishawaka, Ind.

Two air compressors made by the Chicago Pneumatic Tool Co., have been supplemented by a 17 and 10½ x 12-inch direct connected, synchronous motor driven unit made by the Ingersoll-Rand Co., New York.

Book Review

Psychotechnische Beruf seignung-sprufung von Giessereifacharbeitern, by William Bueltmann, paper or cloth, 6 x 9¼ inches, 78 pages, published by Julius Springer, Berlin, Germany, and supplied by THE FOUNDRY, Cleveland, for $2.50 in paper and for $2.75 in cloth plus 15 cents postage. In London the book may be obtained from the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster, for 12s 6d, and 13s 8d respectively, postage extra.

This volume, which is in German, deals with the psychotechnical, trade-suitability examinations of skilled foundry workers. The first chapter discusses the special relations in foundry methods with reference to molders. The second deals with the analysis of the operations and confirmation of ability. Chapter III deals with the test methods and the tests. The fourth chapter is devoted to evaluation of the results and the fifth chapter deals with a reconciliation between the results obtained in the tests and the molder's ability at work. Descriptions of tests employed include those of slowly lifting a small rod, and rapidly placing a rod in a series of small holes. These tests determine steadiness of the hand and co-ordination of hand and eye. Finger pressure, hand pressure, heat-color determination, etc. are included in the tests because these have a bearing upon the skill and judgment of a molder.

Faked Foundry Facts

A Riser

Issues Safety Bulletins

National Safety Council, 108 East Ohio street, Chicago has issued three bulletins; one on the planning of an industrial safety campaign, another on fume poisoning from nitric and mixed acids and the third on chemical burns, their nature and treatment. The first pamphlet is illustrated with posters and exhibits used in the conduct of a safety campaign and gives some of the various ideas used to promote careful workmen. The second leaflet deals with action of fumes, susceptibility, symptoms, prevention, injuries from fumes, first aid treatment and hospital treatment of fume cases. The last folder compares various kinds of chemical burns and describes the treatment that each should receive.

Linde Air Products Co., 205 East Forty-second street, New York, has established a plant at 2603 Floyd street, Louisville, Ky. Mr. Frye is superintendent of the new plant and W. L. Potts, with headquarters at the Cincinnati plant, is the district superintendent.

Offers Novel Discussion

(*Concluded from Page* 668)

also air, that the experiment had the benefit of an unbalanced atmospheric pressure until covered by water and the weight of water afterward and for this reason the results would not be a true and satisfactory conclusion. To experiment further along this line, I imagined that my vessel had an opening 1 inch square through the bottom and the plug or stick fitted the hole so perfectly that there would be neither leakage nor friction and that the stick just merely was entered into the hole and suspended by a string. I believe that if the vessel then were filled with water and the support removed that the stick would drop through the hole down and out. It can readily be seen that in this experiment the atmospheric pressure would be in balance, as both ends of stick would be exposed to the same pressure.

This idea was carried out. I cut a hole in the box and fitted the plug. Of course there was some leakage and some friction. The box or vessel was placed on two sticks across the top of a 12-quart pail in such a manner that the stick could fall freely. A string was fastened to the top of stick and the vessel filled. However, the stick did not float. Then the string was loosened carefully and the stick slipped down through the hole. The experiment was repeated but the stick was placed so that it leaned considerably to one side, that is out of plumb. This time as the water ascended it straightened the stick from a leaning to a plumb position. When the vessel was filled to overflowing the string was loosened and stick fell down through the same as before. These experiments were repeated many times. Since the results always were the same it proved my contention satisfactorily, at least to my own mind.

The reader may easily perform the same experiment and reach his own conclusions as I have mine. I would not, and do not advocate the setting of cores without securing them where there would be a possible chance of them coming up if the iron gets under them, but so far as the law of floating bodies is concerned, I have tried to show that a core with perpendicular sides set plumb and being firmly and evenly set and sealed so that no iron could enter under it, would not float.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

West Point Iron Works, West Point, Ga., has started construction of a plant addition.

Barker Machine & Foundry Co. is establishing a manufacturing plant at Souderton, Pa.

Hobart Mfg. Co., Troy, O., has started construction of a 1-story addition.

Aluminum Co. of America has purchased the Modern Foundry & Pattern Works, Oakland, Calif.

Ohio Steel Foundry Co., Lagonda and Gothic streets, Springfield, O., plans construction of a plant addition. Estimated cost about $100,000.

Seaman Foundry, 2307 Grand avenue, Dallas, Tex., plans installation of additional equipment for manufacture of iron and nonferrous castings.

Ideal Brass Foundry, Jamaica, N. Y., has been incorporated with $20,000 capital, by T. J. Towers, 90-50 Parsons boulevard, Jamaica.

Swayne Robinson Co., Richmond, Ind., has been issued a permit for construction of a foundry addition which will double its size.

Guelph Stove Co., Guelph, Ont., has taken out a permit for the erection of a plant addition to cost $115,000. (Noted May 15.)

Ideal Brass Foundry Inc., New York, has been incorporated with $20,000 capital, by Edward Fratello, 210 McDougal street, Brooklyn, N. Y.

Adams Foundry, 108 South George street, Rome, N. Y., celebrated its ninety-fourth anniversary on July 5.

C. & G. Foundry Co., Indianapolis, has taken over the United Brass Works to enlarge its facilities. Charles J. Geisler is president.

LaPort Foundry Co., LaPort, Ind., now is building an office building at Marquette and Truesdell avenue.

Flynn & Emrich Co., 301 North Holliday street, Baltimore, contemplates building a 1-story foundry building. Estimated cost is about $80,000.

Hull Iron & Steel Foundries, Ltd., Montcalm street, Ottawa, Ont., soon will award contracts for additions and improvements to its plant. These will cost about $200,000.

Central Foundry Co., Eighth avenue, Bessemer, Ala., has plans for a one-story addition to its cast iron pipe plant. It will cost about $20,000. (Noted July 1.)

Birmingham Machine & Foundry Co., and Joubert & Goslin Machine & Foundry Co., both of Birmingham, Ala., have been consolidated as the Goslin-Birmingham Mfg. Co.

Nash Motors Co., Kenosha, Wis., recently broke ground for a one-story addition, 42 x 145 feet, to its foundry at the main works in Kenosha.

Levering Bros., Broadway avenue, Hanover, Pa., has plans for construction of a foundry addition and warehouse. Estimated cost about $100,000.

J. B. Welch, 44 School street, Boston, has awarded a contract for a 1-story foundry addition to Thomas Mulcare Inc., 66 Western avenue, Boston.

Blackhawk Foundry & Machine Co., 323 South Clark street, Davenport, Iowa, has awarded contract for a plant addition to the A. H. Neuman & Co., Des Moines, Iowa.

Barron U. Davis Foundry, Niagara Falls, N. Y., has been incorporated with 50 shares of common stock, by Wallace Orr & Wilcox, Gluck building, Niagara Falls.

Kedzie Foundry Co., Chicago, has purchased the foundry property at 3236 West Thirty-first street, 185 x 340 feet, which it had occupied for many years on lease.

Kennedy Machine & Brass Co., Dallas, Tex., has added a gray iron and nonferrous foundry building, 50 x 100 feet, and plans enlargement of gray iron foundry facilities.

Doehler Die Casting Co. has installed an electric heat treating furnace at its plant at Batavia, N. Y., for treatment of aluminum castings for airplane and outboard motors.

Wheeling Mold & Foundry Co., Wheeling, W. Va., recently poured a steel casting weighing 240,000 pounds, to be used as a hammer block by the Fiat motor works in Italy. To make this casting 331,000 pounds of metal was poured.

Dork Foundry Co., owned by F. W. Dork and P. L. Berke, has opened a foundry at Fifty-second avenue west and Polk street, Duluth. It will produce automotive parts and accessories.

Hill & Peterson Foundry Co., 4533-39 Patterson avenue, Chicago, has been incorporated to do general manufacturing business with a capital of $6000 by William H. Hill, Biger Peterson, and Adolf J. Peterson.

Yale & Towne Mfg. Co., Canal and Market streets, Stamford, Conn., have approved plans for a one-story foundry addition. The new building and equipment will cost about $60,000.

Plantsville Foundry, Southington, Conn., has been incorporated to do general foundry and machine shop business. The firm is capitalized at $50,000. T. W. Thompson, Plantsville, Conn., is president.

P. F. Mork Foundry, 132 Blackhawk boulevard, Beloit, Wis., is building a two story addition to its plant. A wood shop and a small machine shop will be housed in a portion of the new addition.

Follett & Kinney Machine Co. Inc., 58 Essex street, Haverhill, Mass., has been incorporated with $25,000 capital to operate a general foundry and machine shop. Freeman W. Follett, is president and treasurer.

Smith Engineering Corp., 429 Cambridge street, Allston, Mass., has been incorporated with $10,000 capital to engage in busines as toolmakers, brass founders, metalworkers, etc. Herman R. Smith is president.

Plant of the United Iron Works Co., Iola, Kan., has been purchased by a group of local men. It will be operated under the name of Kirk-Morrow Iron Works Co. J. B. Kirk is president.

Garrett Brass & Aluminum Foundry Co., Garrett, Ind., has been incorporated to take over a business of the same name. The company will manufacture and deal in brass, aluminum and other metal castings.

Coshocton Iron Co., Monongahela, Pa., subsidiary of the Combustion Engineering Corp., 200 Madison avenue, New York, has plans for an addition, 160 x 480 feet. The new building and equipment will cost about $130,000.

New Jersey Art Foundry, 433 Tonnele avenue, Jersey City, N. J., has plans for construction of a plant addition costing about $30,000. L. Feinen, 3697 Boulevard, Jersey City, is architect.

Electric Household Utilities Corp., Twenty-second and South Fifty-fourth avenue, Chicago, has a new foundry under construction which is expected to be in operation by Sept. 1. The company formerly operated its foundry at Waukegan, Ill., in leased space.

A new Connecticut foundry company has been organized to specialize in the production of iron castings, according to a report. The new company will occupy the Stewart-Walker plant in Plantsville, Conn., which recently went into bankruptcy. Victor E. Walker of Meriden, Conn., who was president of the bankrupt firm, is named as one of the incorporators of the new organization. Other incorporators are Thomas W. Thomson, who will be president, and Samuel Botwinik of New Haven, Conn.

Sherrill Ambler, Northville, Mich., has purchased the property of the Bell Furnace & Mfg. Co., Northville, Mich. The new owner will continue production and plans the development of the furnace division and an increase in foundry production.

American Foundry Co., Bay Point, Calif., has purchased the plant and property of the Dow Pump & Diesel Engine Co., Alameda, Calif., and will move to that location. The new owners will install additional equipment. A. Searle is general manager.

International Steel Corp., Canton, O., recently incorporated which leased the former plant of the Canton Steel Foundry Co., Allen avenue southeast, to manufacture castings, etc., will remodel the plant and install machinery. (Noted May 15.)

National Steel Ltd., Welland, Ont., has been incorporated to carry on business as manufacturer, foundryman and producer without limitation as to class of product, with a capital of $500,000 and 25,000 shares of no par stock, by Arthur W. Holmested, Leonard V. Sutton, Gertrude H. Sinclair, all of Toronto, and others.

Bro-Dun Metal Products Co., Lancaster, Pa., has bought the plant and equipment of the General Metal Products Co., Lancaster, Pa., and will continue the manufacture of brass, bronze and aluminum castings, bearing and bushing metal. E. P. Brock and J. S. Dunie head the new company.

The Ferracute Machine Co., Bridgeton, N. J., has consummated the purchase of the William T. Barker foundry, Bridgeton. Practically all of the castings made at this foundry since its erection in 1913 have been from Ferracute Machine Co. patterns. No immediate changes in the foundry are contemplated but it is probable that the plant will be enlarged and additional

Central Brass Foundry Co., Neenah, Wis., has been organized by A. M. Schnetzer, 419 East Forest avenue, formerly superintendent of the Neenah Brass Works, and John W. Hewitt, head of the Hewitt Machine Co., Neenah. A new foundry for jobbing work, largely for paper and sulphite mills, is being established on Sanford street, in Menasha, twin city of Neenah. Mr. Schnetzer, who will be active manager of the new business, has been associated with the Neenah Brass Works for 20 years, and for the past 15 years has been general superintendent. He recently disposed of his interests and resigned.

New Trade Publications

CONTROLLERS—Electric Controller & Mfg. Co., Cleveland, recently has published a folder illustrating the value of its time, current controller.

OIL HEATING—Oil Heating Institute, 420 Madison avenue, New York, recently published a bulletin illustrating and describing the oil heating equipment manufactured by its members.

DRYING SYSTEMS—Drying Systems, Inc., 1800 Foster avenue, Chicago, in a current folder, describes the advantages and construction of its traveling fan carriage for drying material which is piled on sticks.